

# Recent Advances and Applications in Modern Synthetic Chemistry

*Edited by:* Dr. Satish Babulal Jadhav



# RECENT ADVANCES AND APPLICATIONS IN MODERN SYNTHETIC CHEMISTRY

## VOLUME - I

Edited by

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**ABSTRACT**

Green chemistry is defined as chemical synthesis that is not harmful to the environment, whether carried out in education laboratories or in industries that produce no or few by-products that pollute the environment. Green chemistry seeks to develop greener synthesis of required chemical products through the use of renewable resources (for example, biomass rather than petrochemical feedstock). It reduces the use of non-renewable resources (e.g., Crude oil).

**KEYWORDS:** Renewable energy, Environmental Protection Agency, Greener synthesis.

**INTRODUCTION**

Medicine, cosmetics, dyes, food items, nano particles, polymers, liquid crystal, paints, bio molecules and agrochemicals are all examples of useful chemistry. Various sophisticated goods can now be easily created. Nonetheless, the chemical process produces not only the desired product, but also the unwanted or undesirable and dangerous component in huge amounts as liquid, gas, or solid. This has turned into a major threat to chemistry. As a result, for synthetic chemists, reducing chemical pollution has become a crucial priority [Anastaset. *al.* 2002, Clark *et. al.* 2002, Matlack *et. al.* 2001, Lancaster *et. al.* 2002, Anastas *et. al.* 2000, Anastas *et. al.* 1994, Clark *et. al.* 1995, Trost *et. al.* 1995).

Green chemistry and sustainability are synonymous. Sustainable development is defined as fulfilling current requirements without jeopardising future generation's ability to satisfy their own needs. Green chemistry concepts are not new or untested; rather, they offer a novel method to achieve sustainability. Mistakes are caused mostly by the chemical and

physical properties of the substances we study. We may also deal with essential difficulties like renewability, toxicity, and worldwide influence by designing the medicine at the molecular level, as well as the type of reaction conditions and the reaction we choose.

As a result of this logic, Green Chemistry has evolved into a complex chemical philosophy. Its theories encourage the development of novel processes and raw materials that reduce the usage and manufacture of hazardous compounds. The following are the two most important elements of green chemistry principles.

1. To begin, green chemistry depicts the conundrum of making the best use of starting materials while reducing waste.
2. It complies with the safety, environmental, and health problems that come with chemical manufacturing, usage, and disposal (Sheldon *et. al.* 2005, Ahluwalia *et. al.* 2004, Clark *et. al.* 2012, Anastas *et. al.* 2007).

## HISTORY

Green chemistry sprang from a series of pre theories and research initiatives (such as atom economy and catalysis) in the years leading up to the 1990s as the public's knowledge of chemical pollution and resource depletion grew. Green chemistry's emergence in Europe and the United States coincided with a shift in environmental problem-solving strategies: a shift away from command-and-control regulation and mandated reductions of industrial emissions at the end of the pipe and toward active pollution control through innovative production technology design. The mid to late-1990s saw the emergence of a collection of concepts currently known as green chemistry as well as a wider acceptance of the word (which prevailed over competing terms such as clean and sustainable chemistry). The Environmental Protection Agency (EPA) in the United States was a pioneer in promoting green chemistry through pollution prevention programmes, funding and professional coordination. At the same time, researchers at the University of New York contributed to the formation of the Royal Society of Chemistry's Green Chemistry Network as well as the publication of the journal Green Chemistry. In 1962, Rachel Carson published *Silent Spring* a mainstream scientific book, it described how particular pollutants wreaked havoc on limited ecosystems. The general public and scientists should read this book serve as a wake-up call, it helped to spark the contemporary environmental movement. The National Environmental Policy Act was approved by Congress in 1969 recognizing the seriousness of the issue (NEPA). A Presidential Council on Environmental Quality was proposed the bill to establish and preserve conditions in which nature and man can exist in fruitful peace (Anastas *et. al.* 1998).

President Richard Nixon founded the United States Environmental Protection Body (EPA) in 1970 as a government regulatory agency focused to environmental protection. The United States Environmental Protection Agency (EPA) was formed by President Richard

Nixon in 1970 as a federal regulatory agency dedicated only to preserving human health and the environment. The use of DDT and other chemical pesticides was banned as the EPA's first significant ruling. The Safe Drinking Water Act of 1974 was one of a series of regulatory measures created by Congress to reduce pollution's environmental impact. The chemical business was rocked in the late 1970s when Love Canal was discovered and made public near Niagara Falls, New York. Thousands of barrels of chemical waste that had been buried by chemical companies for decades rusted through at this and other locations.

Until the 1980s, the chemical industry and the Environmental Protection Agency were primarily concerned with the environmental clean-up and visible poisons but chemists began to adopt a new mind-set. Scientists who grew up during a period of rising environmental awareness began to look into ways to avoid pollution in the first place. Industry and government leaders initiated international dialogues to address the issues and find preventative solutions. Throughout the 1980s, the organization for economy cooperation and development (OECD) an international organisation comprising over 30 developed countries alleged meetings to discuss environment issues. They issued a set of international guidelines aimed at bringing existing chemical processes together and preventing pollution. In 1988, the EPA formed the Office of Pollution Prevention and Toxics to help achieve these environmental goals.

The acceptance of pollution prevention and the formation of green chemistry as a valid scientific area progressed during this decade. The Pollution Prevention Act of 1990 marked a shift in regulatory policy from pollution control to pollution prevention as the most effective way to address these issues. Kenneth G. Hancock, the National Science Foundation's (NSF) chemistry director at the time, made a public pitch for this strategy as a financially viable choice. Chemists from all around the world agreed that this could help to reverse the industry's environmental degradation trend. In the early 1990s, the European Community's Chemistry Council published papers on the subject, including the influential Chemistry for a Clean World. The American Chemical Society's Division of Environmental Chemistry hosted the inaugural conference on these themes, "Benign by Design: Alternative Synthetic Design for Pollution Prevention," which took place in Chicago in 1994. The term green chemistry was coined by the EPA's Office of Pollution Prevention and Toxins which established the collaboration between government, business and academia. President Bill Clinton supported the US EPA's establishment of an annual awards programme in 1995 to recognize scientific innovations in industry and academia. The Green Chemistry Presidential Challenge Awards were born as a result of this. In 1997, the University of Massachusetts in Boston launched the field's first Ph.D. programme in Green Chemistry. Dr. Joe Breen a retired EPA staff member with 20 years of service and Dr. Dennis Hjeresen co-founded the Green Chemistry Institute (GCI) in the same year as an independent charity dedicated to promoting green chemistry. The Green Chemistry & Engineering Conference

was founded by GCI in 1997 and has been held annually since *Green Chemistry: Theory and Practice* co-authored by Paul Anastas and John C. Warner was printed in 1998 and was a game-changer. The twelve Principles of inexperienced Chemistry articulated during this study declared an idea that impressed industrial and educational scientists at the time and still guides the inexperienced chemistry society these days.

The Green Chemistry organization joined the American Chemical Society in 2001 making it the world's largest professional scientific society and membership organization for chemists. In both 2001 (Knowles, Noyori, Sharpless) and 2005 (Chauvin, Grubbs, Schrock) the Nobel Prize in Chemistry was awarded for research in areas of chemistry that were primarily considered to be green chemistry, these Nobel Prizes helped to emphasize the importance of green chemistry research and to raise awareness among scientists that the future of chemistry should be more environmentally friendly. To catalyze and promote engineering and green into chemical industries. The ACS GCI developed an industrial committee for the pharmaceutical business in 2005, two other roundtables one for chemical production and the other for formulator has been established since then.

Green chemistry organizations, conferences and journals have sprouted up all above the globe. Some examples are:

1. MEGREC-The Mediterranean Countries Network on Green Chemistry.
2. The Royal Society of Chemistry's (UK) magazine *Green Chemistry*.
3. Japan's Green and Sustainable Chemistry Network.
4. Australia's Monash University's Centre of Green Chemistry

The current ACS GCI website contains links to additional organizations, schools and conferences. Many schools from playschool to post-graduate now have access to educational and research curricula. Green chemistry and engineering were catalyzed and enabled into chemical industries by the ACS GCI which formed an industrial committee for the pharmaceutical manufacturing in 2005. Since then, four more roundtables have been established for chemical production, formulators, hydraulic fracturing and biochemical technologies (Bulley *et al.* 2000, Centi *et al.* 2003).

## TODAY AND THE FUTURE

Despite all advances in engineering and green chemistry research the ordinary chemical industry has failed to fully adopt the technology. Petroleum still accounts for more than 98 percent of all organic compounds today. Green chemists are aiming to bring their inventions and research from the lab to the boardroom by developing commercially viable solutions that may be adopted by today's industry leaders. During Nexus newsletters and blogs, annual GC &E conferences, industrial roundtables, and diversifying educational and research activities, the ACS Green Chemistry Institute remains central to information, connectivity, and research exchange (Chuck *et al.* 2000, Ravichandran *et al.* 2010).

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