

The 12 Principles Of Green Chemistry



PREVENTION: It is better to prevent waste than to treat or clean up waste after it has been created.



ATOM ECONOMY: Synthetic methods should be designed to maximise the incorporation of all materials used in the process into the final product.



LESS HAZARDOUS CHEMICAL SYNTHESES: Wherever feasible, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.



DESIGNING SAFER CHEMICALS: Chemical products should be designed to affect their desired function while minimising their toxicity.



SAFER SOLVENTS AND AUXILIARIES: The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary where possible and harmless when used.



DESIGN FOR ENERGY EFFICIENCY: Energy requirements of chemical processes should be recognised for their environmental and economic impacts and should be minimised. If possible, synthetic methods should be conducted at ambient temperature and pressure.



USE OF RENEWABLE FEEDSTOCKS: A raw material or feedstock should be renewable rather than depleting whenever technically and economically feasible.



REDUCE DERIVATIVES: Unnecessary derivatisation (use of blocking groups, protection/deprotection, temporary modification of physical/chemical processes) should be minimised/avoided if possible to prevent more reagents and waste.



CATALYSIS: Catalytic reagents (as selective as possible) are superior to stoichiometric reagents (determining the exact proportion of elements to make pure chemical compounds).



DESIGN FOR DEGRADATION: Chemical products should be designed so that at the end of their function, they break down into harmless degradation products and do not persist in the environment.



REAL-TIME ANALYSIS FOR POLLUTION PREVENTION: Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.



INHERENTLY SAFER CHEMISTRY FOR ACCIDENT PREVENTION: Select substances used in a chemical process that minimise potential for chemical accidents, e.g. releases, explosions and fires.