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GREEN CHEMISTRY: SUSTAINABLE APPROACHES IN CHEMICAL ENGINEERING

Green chemistry focuses on designing products and processes that minimize hazardous substances and environmental impact. Introduced by Paul Anastas and John Warner in 1998, it aims to reduce waste, enhance energy efficiency, and utilize renewable raw materials. By adopting these principles, industries can develop safer and more sustainable chemical products while maintaining profitability.

Principles of Green Chemistry:

1. Prevent waste instead of cleaning it up.
2. Maximize material incorporation to minimize waste.
3. Use less hazardous chemicals.
4. Design safer, non-toxic products.
5. Minimize harmful solvents and auxiliaries.
6. Optimize energy efficiency.
7. Use renewable raw materials.
8. Reduce unnecessary derivatization.
9. Use catalysts to improve reaction efficiency.
10. Ensure products degrade safely.
11. Enable real-time pollution monitoring.
12. Design for accident prevention.

Companies Implementing Green Chemistry:

DuPont: Develops bio-based materials like Sorona® and lowers greenhouse gas emissions.

BASF: Produces biodegradable plastics and sustainable agricultural solutions.

PCC Group: Manufactures sustainable surfactants and bio-based chemicals.

PhosAgro: Develops cadmium-free fertilizers for soil and water safety.

Dow Chemical: Creates eco-friendly water purification solutions and biodegradable packaging.

Merck: Implements green chemistry in pharmaceutical research.

Green Chemistry in Belarus. Belarusian State University (BSU): Offers courses and researches biodegradable materials and catalysts.

National Academy of Sciences: Develops sustainable polymers and clean energy technologies.

Belneftekhim Concern: Uses catalytic and energy-efficient technologies to minimize emissions.

National Children's Technopark: Educates young scientists on green chemistry.

Institute of Physical Organic Chemistry: Works on solvent-free reactions and biocatalysis.

Green chemistry transforms chemical engineering by reducing pollution, optimizing resource use, and creating safer products. Companies like BASF, DuPont, and Dow Chemical demonstrate its success, while Belarus advances it through education and research. As environmental concerns grow, collaboration between industries, governments, and academia will drive innovation for a sustainable future.

REFERENCES

1. Anastas P., Warner J. Green Chemistry: Theory and Practice. Oxford University Press, 1998.

2. Clark J. Green Chemistry: Challenges and Opportunities. Green Chem. 1999.

3. Sheldon R.A. Green and Sustainable Chemistry in Practice. Chem. Ind. 2018.

4. Belarusian State University, Department of Chemistry. Research Reports, 2022.

5. National Academy of Sciences of Belarus. Sustainable Chemistry Research, 2023.

6. ACS Green Chemistry Institute. Green Chemistry Innovations. [https://www.acs.org/greenchemistry.html]