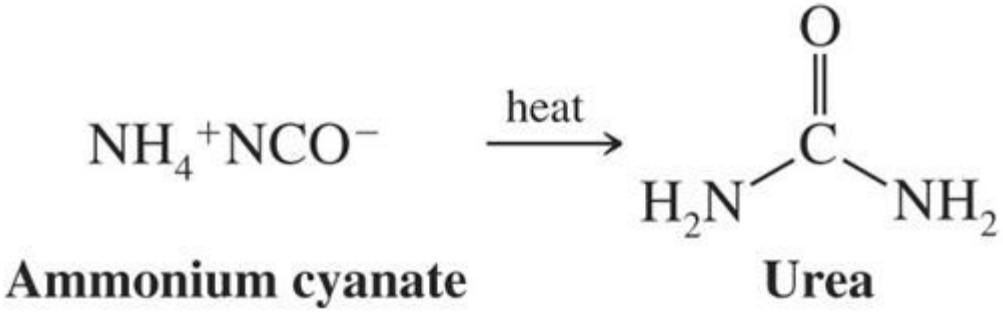
Green Chemistry

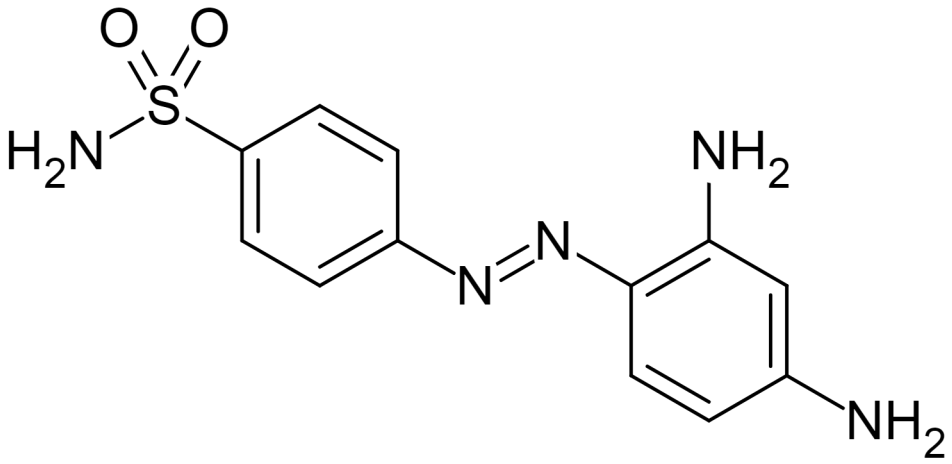
DSE-8, B.Sc. (H) Chemistry, SEM V

Introduction to Green Chemistry

The history of organic synthesis is generally traced back to Wöhler's synthesis of the natural product **urea** from ammonium isocyanate in 1828. This laid to rest the vis vitalis (vital force) theory, which maintained that a substance produced by a living organism could not be produced synthetically. The discovery had monumental significance, because it showed that, in principle, **all organic compounds are amenable to synthesis in the laboratory.**



- **Advances in medical science resulting in the development of drugs and antibiotics resulted in life expectancy from 47 years to 75 years in 1900's. The origins of this industry date back to 1935, when Domagk discovered the antibacterial properties of the red dye, prontosil, the prototype of a range of sulfa drugs that quickly found their way into medical practice.**



- **The world's food supply also increased enormously due to the discovery of hybrid varieties, improved methods of farming, better seeds, use of insecticides, herbicides and fertilizers.**

- **The quality of life on earth became much better due to the discovery of dyes, plastics, cosmetics and other materials.**

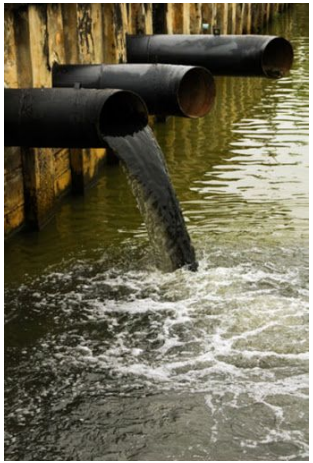
Perkin in 1856 was trying to synthesize the anti - malarial drug quinine by oxidation of N - allyl toluidine with potassium dichromate. This noble attempt, bearing in mind that only the molecular formula of quinine (C 20 H 24 N 2 O 2) was known at the time, was doomed to fail. In subsequent experiments with aniline, fortuitously contaminated with toluidines, Perkin obtained a low yield of a purple - colored product. Apparently, the young Perkin was not only a good chemist but also a good businessman, and he quickly recognized the commercial potential of his finding. The rapid development of the product, and the process to make it, culminated in the commercialization of mauveine, which replaced the natural dye, Tyrian purple.

Consequences of Development

By-products of chemical industries,which are being discharged into the air, rivers/oceans and the land caused pollution. The use of toxic reactants and reagents also make the situation worse.

Air pollution

Industries can also cause air pollution.
Industrial pollution can also impact air quality, as it give out chemical components and gases in the air



Skin problems caused by pesticide exposure.

POLLUTION BY DYE INDUSTRY

Textile mills generate one-fifth of the world's industrial water pollution and use 20,000 chemicals, many of them carcinogenic, to make clothes. Chinese textile factories alone produce about three billion tons of soot—air pollution linked to respiratory and heart disease—every year by burning coal for energy. Most of the world's textile factories are in developing countries where governments can't keep pace with the industry’s massive pollution footprint.

POLLUTION BY PHARMACEUTICAL INDUSTRY

According to Jason Snape, principal environmental scientist at AstraZeneca, “pharmaceuticals are increasingly being detected in the environment, but generally in very, very low amounts. These include highly potent drugs such as the synthetic estrogen used in contraceptives. Higher concentrations [of drugs] can also occur where there is a high population density, inadequate sewage treatment systems, and low dilution in rivers.”

The pollution reached such levels that different governments made laws to minimise it. This marked the beginning of Green Chemistry by the middle of 20th century.

What is Green Chemistry?

Green chemistry is defined as environmentally benign chemical synthesis. The synthetic schemes are designed in such a way that there is least pollution to the environment.

WHAT ARE THE ATTEMPTS TO MINIMISE POLLUTION CAUSED BY CHEMICAL WASTE

1. **To design synthesis for manufacturing processes in such a way that:-**

   The waste products are **minimum.**
   They have **no effect** on the environment.
   Their **disposal** is convenient.

2. For carrying out reactions it is necessary that the starting materials, solvents and catalysts should be carefully chosen.

For example, use of benzene as a solvent must be avoided at any cost since it is carcinogenic in nature. If possible, it is best to carry out reactions in the aqueous phase.

HOW DO WE CHECK TOXICITY OF ANY COMPOUND?

Msds data sheet

3. Synthetic methods should be designed in such a way that the starting materials are consumed to the maximum extent in the final product. The reaction should also not generate any toxic by-products.

Thank you