

Lecture 5.2 – Important Dye Intermediates

Learning Objectives

- Understand the role and synthesis of dye intermediates: H-acid, Koch acid, Vinyl sulphone.
- Recognize their industrial significance and environmental impacts.

1. Introduction to Dye Intermediates

- Dye intermediates are key organic compounds involved in the synthesis of final dye products.
- They help to introduce chromophores and enhance reactivity in the dye molecule.

2. H-Acid

- Full name: 1-Amino-8-naphthol-3,6-disulfonic acid.
- Synthesized from naphthalene via sulfonation, nitration, and reduction.
- Widely used in azo and reactive dye synthesis.

3. Koch Acid

- A sulfonated naphthalene derivative.
- Intermediate for acid dyes.
- Useful due to high water solubility and active functional groups.

4. Vinyl Sulphone

- A highly reactive intermediate used in reactive dyes.
- Forms covalent bonds with cellulose fibers in alkaline conditions.
- Provides high fastness and wash-resistance.

5. Environmental Aspects

- Many intermediates are toxic and environmentally hazardous.

- Safe handling, proper effluent treatment and waste management are essential.

Key Reactions

H-Acid Synthesis: Naphthalene \rightarrow Sulfonation \rightarrow Nitration \rightarrow Reduction \rightarrow H-Acid

Vinyl Sulphone Reactive Dye: $\text{Dye-SO}_2\text{CH=CH}_2 + \text{Cellulose-OH} \rightarrow \text{Dye-O-Cellulose} + \text{CH}_2=\text{CH}_2$

References

1. Dryden's Outlines of Chemical Technology
2. Groggins, Unit Processes in Organic Synthesis
3. NPTEL Module: Industrial Chemistry – Dye Intermediates

Assignment Questions

1. Describe the synthesis steps involved in H-Acid production.
2. Why is Vinyl Sulphone preferred in reactive dye manufacture?
3. What are the industrial safety concerns in dye intermediate handling?