❖ Interaction Between Dyes and Fibers

In the process of dying, the dye molecules bind with the fiber by some sort of attractive force which can be physical or chemical in nature. The fastness of the dye depends upon the nature and extent of these dye-fiber forces. In this chapter, we will discuss the types of interactions between dye and fiber.

➢ *Physical Theory*

According to the physical theory of dye-fiber interaction, dye molecules are retained by the fiber via van der Waal forces or hydrogen bonding.

Some of the most important characteristic features of the physical theory of dye-fiber interaction are given below.

1. The fastness of dye in this type of interaction increases with increasing molecular size.
2. Dye's fastness decreases as the solubility increases.

One of the most common examples of dyes showing this type of interaction is the coloring of the cellulosic by solubilized vat, direct, sulfur, and vat dyes.

➢ ***Chemical Theory***

According to the chemical theory of dye-fiber interaction, dye molecules are retained by the fiber via the chemical bond.

Some of the most important characteristic features of the chemical theory of dye-fiber interaction are given below.

1. The dye as well as fiber, are required to have reactive groups.

2. Dye's fastness decreases as the number of reactive sites increases.

3. In most cases, the bonding's nature is ionic but can also be covalent in some.

4. An electrolyte is added after the 'half dying process' to exhaust the bath.

5. Sometimes the dying-rate is so high that leveling agents are needed for a more uniform effect.

Some of the most common examples include dying of wool or nylon or silk with acid dye, dying of acrylic or silk or cationic polyester with a basic dye, and coloring of anionic polyester with sulfur, vat, reactive or direct dyes. Furthermore, the coloring of cotton by reactive dye material also results in the formation of chemical bonds (covalent interaction).

➢ ***Physio-Chemical Theory***

According to the physio-chemical theory of dye-fiber interaction, dye molecules are retained by the fiber via physical bonds.

Some of the most important characteristic features of the physio-chemical theory of dye-fiber interaction are given below.

1. The fastness of dye in this type of interaction is enhanced by increasing molecular size by the reaction of fiber-retained dye with some other chemical species.

2. One component must be the dye; however, the other component can be the dye or non-dye chemical.

Some of the most common examples of dyes showing this type of interaction are mordant dyeing of wool, mordanting of cotton in basic dyeing, back tanning of dyed protein fiber.

➢ ***Fiber-Complex Theory***

According to the fiber-complex theory of dye-fiber interaction, dye molecules are retained by the fiber via the formation of a complex.

Some of the most important characteristic features of the fiber-complex theory of dye-fiber interaction are given below.

1. The dye on its own is not able to enter the fiber's matrix due to lack of affinity or large molecular structure.

2. The reaction of two different compounds under feasible conditions.

One of the most common examples of dyes showing this type of interaction is cotton's coloring with insoluble azoic.

- ***Solid Solution Theory***

According to the solid-solution theory of dye-fiber interaction, dye molecules are trapped inside by the fiber material under suitable conditions.

Some of the most important characteristic features of the solid-solution theory of dye-fiber interaction are given below.

1. The dyestuff as well fiber, both are in the solid phase.
2. Dye gets trapped in the hydrophobic fiber, forming a solid solution.
3. The dyeing is carried out at a higher temperature to facilitates the passage of dye molecules into the fiber.

One of the most common examples of dyes showing this type of interaction is dying man-made material with disperse dye.

- ***Pigment or Mechanical Theory***

According to the pigment or mechanical theory of dye-fiber interaction, dye molecules are attached to the fiber via a binding agent.

Some of the most important characteristic features of the pigment theory of dye-fiber interaction are given below.

1. The dye has no reactive sites, no affinity for the fiber, and is insoluble in most of the solvents.
2. The fiber becomes more stiff and the dye’s fastness depends upon the film’s longevity.

Some of the most common examples of dyes showing this type of interaction are the dying of fabric, pigment colors.

International Edition

A TEXTBOOK OF ORGANIC CHEMISTRY

Volume I

MANDEEP DALAL

First Edition

DALAL INSTITUTE

Table of Contents

Mandeep Dalal
(M.Sc, Ph.D, CSIR UGC – NET JRF, IIT-GATE)
Founder & Educator, Dalal Institute
E-Mail: dr.mandeep.dalal@gmail.com
www.mandeepdalal.com

Mandeep Dalal is an Indian research scholar who is primarily working in the field of Science and Philosophy. He received his Ph.D in Chemistry from Maharshi Dayanand University, Rohtak, in 2018. He is also the Founder of "Dalal Institute" (India's best coaching centre for academic and competitive chemistry exams), the organization that is committed to revolutionize the field of school-level and higher education in Chemistry across the globe. He has published more than 40 research papers in various international scientific journals, including mostly from Elsevier (USA), IOP (UK), and Springer (Netherlands).

Other Books by the Author

A TEXTBOOK OF INORGANIC CHEMISTRY – VOLUME I, II, III, IV

A TEXTBOOK OF PHYSICAL CHEMISTRY – VOLUME I, II, III, IV

A TEXTBOOK OF ORGANIC CHEMISTRY – VOLUME I, II, III, IV

ISBN: 978-81-952427-3-3
9 788195 242733
MRP: Rs 800.00

DALAL INSTITUTE
..... Chemical Science Demystified .....
Main Market, Sector 14, Rohtak, Haryana 124001, India
(info@dalalinstitute.com, +91-9802825820)
www.dalalinstitute.com