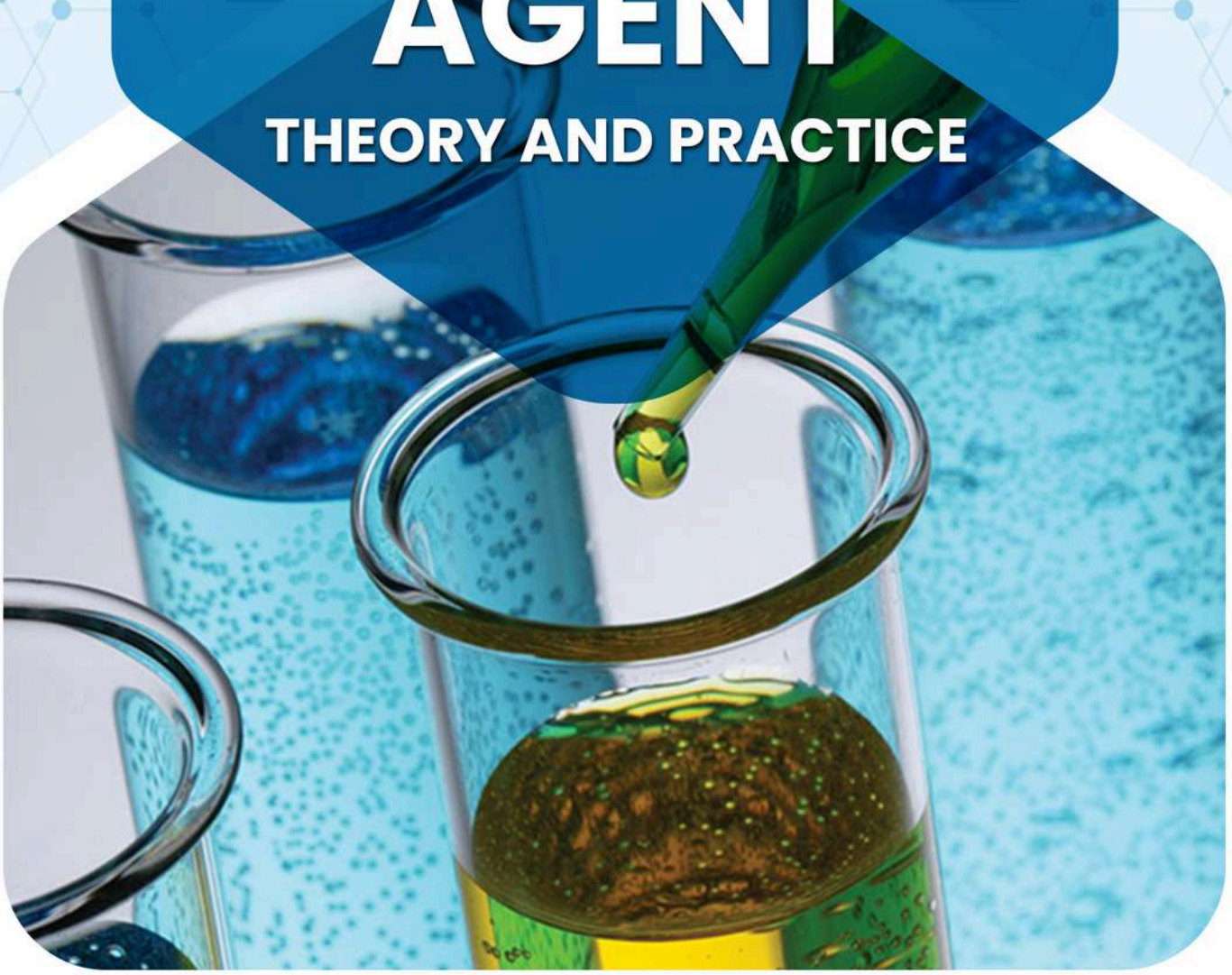
POLYMERUPDATE ACADEMY

EDUCATIONEM RESPONSUM EST

Gramaudyogik Shikshan Mandal's MIT A Group of Academic & Research Institutions AURANGABAD

SILANE COUPLING AGENT

THEORY AND PRACTICE



Prepared & Conducted by

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Summary

Product Quality is a crucial aspect encompassing various characteristics and requirements. Depending on the application or useability of product, the quality can be evaluated based on different factors in accordance with ISO-9001.

These factors include

a) Aesthetics

b) Product's performance under desired service conditions

c) Dimensional stability

d) Uniform and consistent properties throughout the product

e) The requirement of failure under specific conditions

f) End-of-life cycle (sustainability)

In addition, achieving high-quality products depends on the choice of materials (base and with additives), manufacturing techniques and processing conditions, service conditions, environmental factors, and product design (degree of complexity).

Summary

Focusing on the choice of materials with polymers such as thermoplastics, thermosets, rubbers in particular, numerous additives are used to tune/enhance their material properties. For instance, fillers (particulate or fibrous) in desired amounts are incorporated inside a polymeric material to improve mechanical properties. However, in such circumstances, the composition tends to become a heterogeneous, multi-phase system comprising of three distinct phases:

i) Base polymer matrix

ii) Fillers

iii) Polymer-filler interface

To achieve higher mechanical properties, the polymer-filler interfacial strength is important and is strongly dependent on the compatibility of polymer matrix and fillers used. For instance, if the polymer matrix and fillers are incompatible with each other, the interface between them becomes weak and susceptible to crack initiation and propagation under external stress, ultimately resulting in product failure.

Summary

However, on a commercial scale, the compatibility between polymer and fillers is improved by using coupling agents. Coupling agents play a vital role in enhancing the interfacial strength between the two systems, thereby promoting effective stress transfer across the system, leading to better product performance.

In this training module, the participants will have an opportunity to learn and understand fundamental concepts about types of coupling agents, their interactions with polymers and fillers via appropriate reactions and/or mechanisms, selection criteria for appropriate coupling agents, and their applications in various sectors of polymer industry. As silane-based coupling agents are predominantly used and have proven effective in improving the compatibility and performance of polymeric materials, the focus of training module will be extensively on Silanes.

Who this course is for?

- Chemical Engineers and Chemists
- Industry Professionals from Composites, Rubbers, Blends sectors
- Manufacturing Professionals
- Professionals from the Adhesives & Coatings Industry
- Quality Control and Assurance Personnel
- R&D Managers
- Academic Researchers and Students
- Industry Consultants

What will you learn?

Attending a course on "Silane Coupling Agent: Theory & Practices" would provide participants with a comprehensive understanding of the following key aspects:

- Fundamental Concepts: Learn silane agent structure, properties, and interactions with polymers and fillers.
- Interfacial Chemistry: Understand complex interactions between agents, polymers, and fillers for optimal material performance.
- Material Compatibility: Discover how agents enhance polymer-filler compatibility, boosting mechanical properties and adhesion.
- Material Performance Enhancement: See how agents improve strength, durability, and thermal stability.
- Applications: Learn agent use in plastics, rubbers, composites, coatings, and more.
- Quality Improvement: Understand how agents enhance consistency and reduce defects.

What will you learn?

- Troubleshooting: Tackle troubleshooting and issues related to agents.
- Sustainability: Explore how agents extend product life and reduce waste.
- Case Studies: Practical examples and case studies will illustrate real-world applications of silane coupling agents, showcasing their impact on material properties and performance.

By attending this course, participants will be equipped with the knowledge and skills necessary to make informed decisions in material selection, processing optimization, and product design.

Lecture 1: Basics/Fundamentals

- History, Terms/Definitions, Types
- Review of Status, Trends, and Challenges
- Bonding through Coupling Agents - Theories

Lecture 2: Silane coupling agents Chemistry and Modification

- Chemical composition
- Silicon-carbon bond formation
- Reactions of various functional groups

Lecture 3: Surface Chemistry at Interface, and Mechanism

- Silanes at the Interface
- Brief introduction about Instrumental Techniques used to study characteristics of Silane Layers
- Reactions at Interface, surface modifications

Lecture 4: Role of Silane coupling agents in adhesion

- Composites
- Mineral Surfaces
- Metals
- Polymers

Lecture 5: Performance and Applications

- General concepts and review
- Composites
- Thermosets
- High-Temperature Resins
- Adhesives and Surface Coatings
- Antimicrobials

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Dr Hemant Joshi is a former Professor at School of Polymer Engineering, MIT World Peace University, Pune. He has more than 3 decades of demonstrated expertise in academia, research, consultancy and a wide range of administrative responsibilities. Dr. Joshi's areas of interest comprise Structure-Property-Processing-Performance Relations, Polymer Waste Management and Environment, Polymeric Materials and Application (including rubbers, blends & composites, biopolymers), Fiber Technology, and Testing & Characterization. His wide-ranging technical skills expand to Characterization techniques (FTIR, DSC, TGA, GPC, XRD, etc.), Testing methods (Tensile, Impact, Flexural, Vicat Softening Point, HDT, etc.), Processing and Compounding, Wet lab & Synthesis, Process Optimization.

Dr. Joshi has conducted UG and PG theory classes and laboratory sessions in Polymer Structure-Property Relationships, Polymeric Materials, Testing & Characterization, Blends & Composites, Fiber Technology, Adhesives, Waste Management, Polymer Chemistry, Specialty Polymers, and Elastomer Technology.

Dr. Joshi has been the Chairman, Examiner and Moderator for several courses. Dr. Joshi has a good number of projects to his credit, mostly in collaboration with noted industry professionals. He has also participated in key industry seminars and guest lectures as well as has written for reputed publications.

Dr. Joshi has obtained his Bachelor of Engineering (Polymer) from MIT, Pune in 1991 while Doctor of Philosophy, Department of Chemical Engineering from IIT, Bombay in 2008.

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THANK YOU

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