DEPARTMENT OF
POLYMER
AND SURFACE
ENGINEERING
Empowering skills and knowledge about latest research in the field of Polymer & Surface Coating Technologies.

MISSION:
To Pursue world class Programs on Excellence in Education & Research in the area of Polymer & Coating Technology for the sustainable development of Industries that require trouble shooting competencies in these core areas of knowledge.

The Department of Polymer and Surface Engineering was established in 1946 and subject to many changes in the name. Earlier it was known as Paints, Pigments and Varnishes (PPV) Section and was steered in the beginning by none other than Professor N.R. Kamath, a famous chemical engineer, graduate of first batch of B.Sc. (Tech.), in 1936, who later migrated to IIT-Bombay as Head of Chemical Engineering and Deputy Director. The B.Sc. (Tech.) courses in plastics and paints technologies were started in 1946 and have been popular throughout the world. Several small and medium industries covering plastics, paint, printing ink, adhesive, sealers and allied industries have been founded by the graduates of the Department and maintained excellent connectivity with industry.

The Department runs two B. Tech./M.Tech/Ph.D. programmes: Polymer Engineering and Technology, and Surface Coating Technology.

What is Polymer Science and Engineering
Polymer science and engineering is a broad, interdisciplinary field that brings together various aspects of chemistry, physics, and engineering for the understanding, development, and application of the materials science of polymers. Many of the existing engineering programs provide a good foundation for work in polymer science and engineering.

A polymer is a chemical compound with large molecules made of many smaller molecules (monomers) of the same kind typically tens of thousands to millions. Some polymers exist naturally and others are produced synthetically. Starch, cellulose, proteins, and DNA are examples of natural polymers, while polyolefins, PVC, polycarbonate, rubber, Teflon, and PEEK etc. are examples of the synthetic variety. Both classes possess a number of highly useful properties that are as much a consequence of the large size of these molecules as of their chemical nature. Although most synthetic polymers are organic, that is, they contain carbon as an essential element along their chains, other important polymers, such as silicones, are based on noncarbon elements.

The first modern example of polymer science synthesis of derivatives of the natural polymer cellulose, producing new, semi-synthetic materials, such as celluloid and cellulose acetate. The World War II era marked the emergence of a strong commercial polymer industry. The limited or restricted supply of natural materials such as silk and rubber necessitated the increased production of synthetic substitutes, such as nylon and synthetic rubber. In the intervening years, the development of advanced polymers such as Kevlar and Teflon have continued to fuel a strong and growing polymer industry.

Although progress in polymer science and engineering can be considered ground-breaking, opportunities are abundant for creating new polymeric materials and modifying existing polymers for new applications: depolymerization and polymer recycling; oxo and biodegradable polymers; nano-composites, and the like. Scientific understanding is now replacing empiricism, and polymeric materials can be designed on the molecular scale to meet the ever more demanding needs of advanced technology. The possible control of synthetic processes by biological systems is promising as a means of perfecting structures. New catalysts offer the opportunity to make new materials with useful properties, and the design of new specialty polymers with high-value-added applications is an area of rapidly increasing emphasis. Theory, based in part on the availability of high-speed computing, offers new understanding and aids in the development of improved techniques for preparing polymers as well as predicting their properties. Analytical methods, including an array of new microscopic techniques particularly suited to polymers, have been developed recently and promise to work hand-in-hand with theoretical advances to provide a rational approach to developing new polymers and polymer products. The field of polymer science and engineering therefore shows no sign of diminished vigor, assuring new applications in medicine, biotechnology, electronics, and communications that will multiply the investment in research many times over in the next few decades.

The education provided to the students is the blend of practice and theory related to polymer science and engineering. The students learn to develop systems which require trouble shooting competencies in these core areas of knowledge.

The physical, chemical and mechanical properties of a material surface determine its applicability in many technical devices. Numerous applications could not be realized without the use of surface modifications, coatings and thin film technology. Therefore, the need for efficient and effective methods of surface modification is becoming increasingly evident to allow the production of far superior products in terms of wear resistance, corrosion protection, enhanced biocompatibility, thermal insulation, improved optical and altered electronic properties. Coating technologies of particular interest include physical and chemical vapor deposition, thermal spraying, electrochemical deposition, sol-gel-syntheses, and plating. Surface modification includes directed energy techniques such as ion, electron and laser beams as well as etching procedures and thermo-chemical diffusion. Beyond that, mono-layers (e.g. SAM, Langmuir-Blodgett) have attained high significance in preparing thin films to modify biomedical surfaces. Recent novel techniques to prepare patterned surfaces (e.g. nano-imprint lithography, micro-contact printing) have proven their potential for the fabrication of integrated circuits and bioactive implants. Thus, this course offers an exciting field of study.

New trends related to surface engineering and coating technology for the synthesis of functional materials surfaces including novel fabrication methods, materials and applications, new characterization techniques as well as numerical simulation and modeling are some of the areas of research.

The Department is supported by University grand commission, Department of science and technology and other coating industries.
SHASHANK T. MHASKE
Ph. D (Tech) Chemical Technology
Professor of Polymer Technology

Publications (peer reviewed) so far: 2018-19 - 20, Total - 151
Patents: 6
h-Index: 19
Citations: 1668
Subjects taught:
• Compounding and polymer processing
• Nanotechnology and their applications
• Evaluation and characterization of polymers
• Polymer chemistry
• Paint processing
• Pigment synthesis
• Synthesis and characterization of raw materials
• Nano materials

Research interests:
• Novel approaches for synthesis of nanomaterials
• Sol gel techniques
• Cellulose based nanoparticles and whiskers
• Bio nanocomposites
• Development of nano-containers by layer-by-layer (LBL) assembly

Professional Activities:
• Associate Professor, Department of Polymer and Surface Engineering, Institute of Chemical Technology (ICT), 2003- till date.
• Vice Chairman, IPI, Mumbai
• Head Warden, ICT Mumbai (2018)
• Faculty Placement Incharge, Department of Polymer Science & Engineering, ICT
• Secretary, UDCT Alumni Association (2010-14)
• Secretary, The Colour Society (2014-15)
• Governing Member, The Society for Polymer Science, India
• Associate Member, ISSPA
• Member, Solvent Excluders Association of India
• Visiting Faculty at SIES School of Packaging, Garware Institute, Amaravati
• University, Indian Plastics Institute
• Jury Board Member, AIPMA Exhibition

Publications

<table>
<thead>
<tr>
<th>No</th>
<th>Title and Authors</th>
<th>Journal</th>
<th>Vol</th>
<th>Pages</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>AgBr and AgCl nanoparticle doped TEMPO-oxidized microfiber cellulose as a starting material for antimicrobial filter, Sumit S. Lal, Shashank T. Mhaske</td>
<td>Carbohydrate Polymers</td>
<td>191(1)</td>
<td>266-279</td>
<td>2018</td>
</tr>
<tr>
<td>3</td>
<td>Development of tri-functional biobased reactive diluent from ricinoleic acid for UV curable coating application, Ganesh Phalak, Deepak Patil, Shashank Mhaske</td>
<td>Industrial Crops and Products</td>
<td>119(1)</td>
<td>9-21</td>
<td>2018</td>
</tr>
<tr>
<td>4</td>
<td>Design and synthesis of bio-based epoxidized alkyd resin for anti-corrosive coating application, Deepak Patil, Ganesh A. Phalak, Shashank T. Mhaske</td>
<td>Iranian Polymer Journal</td>
<td>27 (10)</td>
<td>709-719</td>
<td>2018</td>
</tr>
<tr>
<td>5</td>
<td>Influence of (methacryloxyethyl) methylidimethoxysilane on DCP cured EPDM/PP thermoplastic vulcanizates, Manoj Mali, Aditi Marathe, Shashank Mhaske</td>
<td>Journal of Vinyl and Additive Technology</td>
<td>24(4)</td>
<td>304-313</td>
<td>2018</td>
</tr>
<tr>
<td>6</td>
<td>Novel catechol-derived phosphorus-based precursors for coating applications, Megh Patel, Siddhesh Mestry, Ganesh Phalak, Shashank Mhaske</td>
<td>Polymer Bulletin</td>
<td>-</td>
<td>1-21</td>
<td>2019</td>
</tr>
<tr>
<td>7</td>
<td>Novel approach for the preparation of a compatibilized blend of nylon 11 and polypropylene with polyhydroxybutyrate: Mechanical, thermal, and barrier properties, A. A. Gadgeel, Shashank Tejrao Mhaske</td>
<td>Journal of Applied Polymer and Science</td>
<td>48(52)</td>
<td>1-21</td>
<td>2019</td>
</tr>
<tr>
<td>8</td>
<td>Kafirin-derived films for sustainable development by amimation and esterification, Umesh R. Mahajan, Shashank T. Mhaske</td>
<td>Polymer Bulletin</td>
<td>-</td>
<td>1-17</td>
<td>2019</td>
</tr>
</tbody>
</table>
9. o-Phenylenediamine-derived phosphorus-based cyclic flame retardant for epoxy and polyurethane systems, Sakshi Arora, Siddhesh Mistry, Durva Naik, Shashank T. Mhaske
   Journal of Coatings Technology and Research
   16(2) 531-542 2019

10. Synthesis of microporous interconnected polymeric foam of poly (glycidyl methacrylate-co-divinyl benzene-co-butyl acrylate) by using aqueous foam as a template, Arij Gadgeel, S.T. Mhaske
   Colloids and Surfaces A: Physicochemical and Engineering Aspects
   563 193-205 2019

   Journal of Coatings Technology and Research
   5(1) 1-6 2019

   Journal of Polymer & Composites
   2(2) 1-34 2019

13. Cardanol derived P and Si based precursors to develop flame retardant PU coating, Siddhesh Mistry, Rucha Kakatkar, S.T. Mhaske
   Progress in Organic Coatings
   129 59-68 2019

   Journal of Polymer & Composites
   2(2) - 2019

   Journal of Polymer & Composites
   13(2) - 2019

   Journal of Polymer & Composites
   12(2) - 2019

17. Effect of 2-aminothiazole on antimicrobial activity of waterborne polyurethane dispersions (WPUDs), Siddhesh U. Mistry, Deepak M. Patil, Shashank T. Mhaske
   Polymer Bulletin
   76(4) 1899-1914 2019

18. Development of Primer as a Value-Added Product from Waste PET, Aarti P. More, Shashank Mhaske
   Journal of Thin Films, Coating Science Technology and Application
   2(3) - 2019

   Journal of Thin Films, Coating Science Technology and Application
   1(3) - 2019

   Journal of Coatings Technology and Research
   16(3) 807-818 2019

---

PRAKASH A. MAHANWAR
Ph. D (Tech)
Professor of Polymer Technology

Ph.D. (Tech.) –
Completed 17, Ongoing 7
Ph.D. (Sc) -
Completed 65, Ongoing 22

Research publications:
International- 151
Patents :
International - 01
Indian - 01
Sponsored projects:
Government- 4
Private- 11

Citations: 1356
h-Index: 19
Patents : 2018-19 – 18, total - 73

Publications (peer reviewed) so far: 2018-19 – 18, total - 73

Research Interests:
- Plastic waste recycling
- Microencapsulation
- Control release formulation
- Bio-degradable formulation
- Nanomaterials
- Polymer blends
- Polymer composites

Publications

<table>
<thead>
<tr>
<th>No</th>
<th>Title and Authors</th>
<th>Journal</th>
<th>Vol</th>
<th>Pages</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Polyacrylate/silica hybrid materials: A step towards multifunctional properties, Ingita Tiwari, P. A. Mahanwar</td>
<td>Journal of Dispersion Science and Technology</td>
<td>40(7)</td>
<td>925-957</td>
<td>2019</td>
</tr>
<tr>
<td>2</td>
<td>Lignin: Renewable Raw Material for Adhesive,</td>
<td>Open Journal of Polymer Chemistry</td>
<td>9(2)</td>
<td>27-38</td>
<td>2019</td>
</tr>
<tr>
<td>3</td>
<td>Structure, mechanical and thermal properties of polypropylene based hybrid composites with banana fiber and fly ash, M B Kulkarni, S Radhakrishnan, N Samarth, P A Mahanwar</td>
<td>Materials Research Express</td>
<td>6(7)</td>
<td>1-34</td>
<td>2019</td>
</tr>
<tr>
<td>4</td>
<td>Advances in self-crosslinking of acrylic emulsion: what we know and what we would like to know, Sumit Parvate, Prakash Mahanwar</td>
<td>Journal of Dispersion Science and Technology</td>
<td>40(4)</td>
<td>519-536</td>
<td>2019</td>
</tr>
<tr>
<td>5</td>
<td>Study of Cross-Linking between Boric Acid and Different Types of Polyvinyl Alcohol Adhesive, Ravindra V. Gadhave, Prakash A. Mahanwar, Pradeep T. Gadekar</td>
<td>Open Journal of Polymer Chemistry</td>
<td>9(1)</td>
<td>16-26</td>
<td>2019</td>
</tr>
</tbody>
</table>
6 Cross-linking of Polyvinyl Alcohol/Starch Blends by Epoxy Silane for Improvement in Thermal and Mechanical Properties, Ravindra V. Gadhave, Prakash A. Mahanwar, Pradeep T. Gadkar
BioResources 14(2) 3833-3843 2019

7 Evaluation of Polyethylene Terephthalate Microfibers as Reinforcement for High Density Polyethylene and Effect of Silane treated fibers on Properties of the Composite, M. Prashar Bhatnagar, P. Mahanwar
Journal of Materials and Environmental Sciences 10(12) 1250-1257 2019

8 Effect of glutaraldehyde on thermal and mechanical properties of starch and polyvinyl alcohol blends, Ravindra V. Gadhave, Prakash A. Mahanwar, Pradeep T. Gadkar
Designed Monomers and Polymers 22(1) 164-170 2019

9 Effect of vinyl silane modification on thermal and mechanical properties of starch-polyvinyl alcohol blend, Ravindra V. Gadhave, Prakash A. Mahanwar, Pradeep T. Gadkar
Designed Monomers and Polymers 22(1) 159-143 2019

10 Bio efficacy and Controlled Release Performance of Microencapsulated Hexaconazole against Powdery Mildew Disease on Field Pea, Vinayak Kamble, Manohar Sawant, Prakash Mahanwar
Journal of Materials and Environmental Sciences 10(6) 533-542 2019

11 Effect of gamma irradiation dose on pthalate free PVC dyed thin film dosimeter P. Oberoi, C. Maurya, P. Mahanwar
Journal of Materials and Environmental Sciences 10(6) 533-542 2019

12 Mechanical, Thermal and Morphological Properties of Recycled and Virgin PC/ wollastonite Composite and its Compatabilization by SBC, Rohit S. Tarade, Prakash A. Mahanwar
Journal of Materials and Environmental Sciences 10(4) 357-366 2019

13 Insights into the preparation of water-based acrylic interior decorative paint: tuning binder’s properties by self-crosslinking of allyl acetoacetate – hexamethylenediamine, Sumit Parvate, Prakash Mahanwar
Progress in Organic Coatings 126 142-149 2019

14 Recent developments in the volatile corrosion inhibitor (VCI) coatings for metal: a review, Sukanya Gangopadhyay, Prakash A. Mahanwar
Journal of Coatings Technology and Research 15(4) 789-807 2018

15 To study the effect of boric acid modification on starch-polyvinyl alcohol blend wood adhesive, Ravindra V. Gadhave, Pratik Sanjiv Kasbe, Prakash A. Mahanwar, Pradeep T. Gadkar
Journal of the Indian Academy of Wood Science 15(2) 190-198 2018

16 Review on Opacifying Polymeric Pigment: Reconceive Hiding, Siddhi Shah, Prakash A. Mahanwar
Journal of Coatings Science and Technology - 59-69 2018

RAMANAND N. JAGTAP
Ph. D (Tech)
Professor of Polymer Technology

Publications (peer reviewed) so far: 45
Patents: 31
h-Index: 12
Citations: 628

Research interests:
- Recycling of e-waste
- Antimicrobial Polymer and Paints
- Heat reflective coatings
- Corrosion
- Eco friendly coating, Flame Retardant Coating
- U.V Radiation Polymerization, Microencapsulation

Research students:
Ph.D. (Tech.): Completed 11, Ongoing 14
Ph.D. (Sc): Ongoing 2
M.Tech.: Completed 63, Ongoing 14

Research publications:
- International - 151
- Indian - 01

Sponsored projects:
- Government- 4
- Private - 11
4 Effect of carbonized watermelon rind powder on the mechanical and thermal properties of unsaturated polyester composites: A special insight to chemical resistance and value addition, Kunal K. Wadgaonkar, Linchon B. Mehta, Pratiket B. Bamane, Ramamoorthy Pon Kumar, Ramanand N. Jagtap

Advances in polymer technology 37(8) 3421-3431 2018

5 Synthesis of electroactive tetraaniline-based acrylic polyol by atom transfer radical polymerization for anticorrosive coating application, Gunawant P. Lokhande, Ramanand N. Jagtap

Journal of Coatings Technology and Research 15(6) 1239-1309 2018

6 Microstructural, thermal and rheological correlations to mechanical response of polyamide-6/glass filled/polyetherimide blend: effect of ethylene-octene copolymer on toughening of blend, Linchon B. Mehta, Kunal K. Wadgaonkar, Pratiket B. Bamane, Pon Kumar Ramamoorthy, Ramanand N. Jagtap

Journal of Materials Science 53(16) 11378-11392 2018

ANAGHA A. SABNIS
Ph. D (Tech)
Assistant Professor (Dr.) of Polymer Technology

Publications (peer reviewed) so far
: 46
Patents: 02
h-Index: 11
Citations : 578

Research interests:
• Flame retardant coating
• Emulsion Polymerization
• PET recycling
• Bio-based Coatings
• Electrical Insulation
• Green routes for Polymer synthesis

Ph.D. (Tech.):
Completed 3, Ongoing 4
M. Tech.:
Completed 10, Ongoing 10
Research publications:
International - 20

<table>
<thead>
<tr>
<th>No</th>
<th>Title and Authors</th>
<th>Journal</th>
<th>Vol</th>
<th>Pages</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anticorrosive and insulating properties of cardanol based anhydride curing agent for epoxy coatings, Wazarkar, K., Kathalewar, M., Sabnis, A.</td>
<td>Reactive and Functional Polymers</td>
<td>122</td>
<td>148-157</td>
<td>2018</td>
</tr>
<tr>
<td>3</td>
<td>Effect of pendant functional groups on curing kinetics and final properties of cardanol-based benzoxazines, Wazarkar, K., Sabnis, A.</td>
<td>Journal of Coatings Technology Research</td>
<td>15(3)</td>
<td>555-569</td>
<td>2018</td>
</tr>
<tr>
<td>4</td>
<td>Cardanol based anhydride curing agent for epoxy coatings, Wazarkar, K., Sabnis, A.</td>
<td>Progress in Organic Coatings</td>
<td>118</td>
<td>9-21</td>
<td>2018</td>
</tr>
<tr>
<td>6</td>
<td>Synergistic effect of P–S and crosslink density on performance properties of epoxy coatings cured with cardanol based multifunctional carboxyl curing agents, Wazarkar, K., Sabnis, A.</td>
<td>Reactive and Functional Polymers</td>
<td>128</td>
<td>74-83</td>
<td>2018</td>
</tr>
</tbody>
</table>
Phenalkamine curing agents for epoxy resin: characterization and structure property relationship, Wazarkar, K., Sabnis, A.S. 

Synthesis and characterization of ricinoleic acid derived monomer and its application in aqueous emulsion and paints thereof, Mhadeshwar, N., Wazarkar, K., Sabnis, A.S. 

UV-curable flame-retardant coatings based on phosphorous and silicon containing oligomers, Naik, D., Wazarkar, K., Sabnis, A. 

Phosphorus containing bio-based epoxy resin 

Conferences: 
Invited speaker in spsi macro@ IISER Pune 19-22 Dec 2018