INTERMEDIATE MODULE 310
Media – Thermoplastic Powder Coatings

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Summary

Polyethylene powders were first produced in the 1940s for the rotomolding Industry by what is referred to as the ambient grinding process. The fluidised bed powder coating process was developed in the early 1950s by Dr Erwin Gemmer, a German scientist. This coating method required finer powders than those suitable for rotational moulding and thus necessitated improvements in grinding technology. Also, during this decade, the first Nylon powders based on Nylon 11 were introduced. In the early 60s, it was realised the PVC powder made by the suspension process naturally had the right particle size for fluidised bed use. Adhesive primers were required for all these thermoplastics if long term adhesion was required. The following decades produced a wider range of powders including those based on nylon 12, polyethylene copolymers, polypropylene and a number of fluoro-polymers. Many of these were developed with self-adhesive properties.

Electrostatic powder spray technique was not developed commercially until the mid to late 60s. Using this coating process, thermosetting resin-based systems first started to be used, and cryogenically (freeze) ground nylon powders were produced for application by the electrostatic process in the early 70s. By the 90s many polyolefin and fluoropolymer coatings could be applied electrostatically, thanks to improvements in cryogenic grinding.

In the early 70s, the Middle East Oil crisis occurred. As a result of this, solvents used for solvent-based paints became in short supply, and therefore their price increased significantly. In the same decade, environmental issues caused by solvents were being recognised in America. Thus, the Los Angeles County's Rule 66 (1966) followed by the Federal E. P. A. (Clean Air Act of 1970) guidelines severely restrict the quantity and type of solvents which could be released into the atmosphere. Both of these factors encouraged the rapid growth away from solvent-based paints to dry powder paints, more commonly called thermosetting powders. There was also a marked but less significant growth in thermoplastic powders.

Thermoplastics are the foundation on which powder coating technology was built, and the coating technologist should be aware of the principles that govern their use.

This module describes the types of thermoplastics available for coating applications, their important properties and their uses. The module also serves as a useful, general introduction to the nature of polymeric materials.

It is expected that it will take approximately 8 to 10 hours to complete this module, including the practical work involved.

Structure of the Module

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Learning Objectives

For each topic in the module, there is a learning objective. These objectives are listed immediately before the Study material.

Marking Scheme

The marks are allocated to the different features of the module, as follows:

PAX 1	35%
CMA	20%
End Test	45%
TOTAL	100%

An overall mark of 50% or more is necessary for successful completion of the module, with students achieving at least 40% of the marks available in each element
Self Assessment Questions (SAQ's)

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The answers to SAQs can be found in Appendix 1. If you have any difficulties, go over the text again to make sure that you understand the answer. Ask your Tutor or Mentor to explain anything you do not understand.

Practical Attendance Exercises (PAXs)

In Section 2, you will be asked to carry out a piece of experimental work. The PAX can be found in Appendix 2. If you have any difficulties in setting up the experiments or in finding suitable equipment, ask your Tutor or Mentor for advice.

Computer Marked Assessments

When you have finished the module, a note in the text will guide you to the Computer Marked Assessment (CMA) on the website. Send the completed CMA to your Tutor BCF for marking. Receipt of the CMA at BCF will also tell them that you have completed the module and that, if necessary, they must arrange an End Test.

The Module Calendar

We expect that the amount of learning material in this module can be completed within a month of starting.

Note: *The subject of Thermoplastic powders is dealt with in detail in*:

Polymer Powder Technology – *Edited by M. Narkis & N.Rosenzweig* – Wiley
http://eu.wiley.com

More detailed information about thermoplastics can be found in:

Plastic Materials by J A Brydson – Butterworth-Heinmann Ltd

MODULE OBJECTIVES

At the end of this module, you should be able to do the following:

Section 1 - Introduction to thermoplastic media

1.1. Define thermoplastic behaviour, comparing the phenomena with thermosetting behaviour.

1.2. Define the term 'polymer' and give examples of the principal thermoplastic resins used as coating powders.

Section 2 – Methods of applying Thermoplastic Coatings

2.1. Understand the five major methods of applying thermoplastic powders to metal.

Section 3 - Properties of thermoplastics

3.1 Explain the relationship between molecular weight, melt viscosity and flow properties in thermoplastic polymers.

3.2 Define glass transition temperature, its importance in powder coating resins and its relationship to softening temperature and melt point

Section 4 – Basic Chemistry of Molecular Chains

4.1 Describe the chemical structure and basic properties of polyethylene, polyamide and polyvinyl chloride media.

4.2 Describe how polyethylene and PVC powders are produced.

Section 5 - Applications for thermoplastics

5.1 Understand thermoplastic coatings why and when thermoplastic coatings are preferred to other coatings

5.2 The advantages and disadvantages of the various thermoplastic coating materials.

5.3 Understand the applications for various thermoplastics and the reasons why they are used.

Section 6 – Factors affecting Formulation

6.1 Describe the factors that need to be considered when formulating thermoplastic powders.

6.2 Discuss the health and safety issues affecting the choice of additives when formulating PVC compounds.