

INTERMEDIATE MODULE 311

Media – Thermosetting Powders

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Summary

Thermosetting coating powders have gained a sizeable foothold in the industrial coating field. As with any coating, the medium is the predominant factor determining performance.

This module identifies the types of thermosetting media used in the formulation of coating powders, describing some of the basic chemistry involved. Details are given of the important properties that development chemists look for when selecting the component resins and hardeners.

Included in the text are examples of typical raw materials and details of some of the principles involved in creating a coating medium. The module also introduces some of the more recent innovations in the field, which have been developed to improve features such as appearance and performance or to reduce curing temperatures.

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

Prerequisites

IMPORTANT NOTE: At various points throughout this module, reference is made to the chemical triglycidyl isocyanurate (TGIC), used as a curing agent in polyester powder coatings. In the UK, TGIC is classified as a Category 2 mutagen and is therefore subject to restrictive control measure, as specified in the *Control of Substances Hazardous to Health Regulations 2002* for such materials.

Powder manufacturers within the British Coating Federation have agreed unilaterally to remove the material from their formulations. However, references to its use have not been removed because TGIC and TGIC-based powder coatings are still widely used outside the UK and can even be used within the UK, under strict controls.

For further information on this topic, please read the following documents, issued by The Health & Safety Executive:

- *Engineering Information Sheet No 15 (rev2)*
- *Controlling exposure to coating powders HSG203 - ISBN 0 7176 1761 0*

Copies can be downloaded free from the HSE's website.

Structure of the Module

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

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	<u>45%</u>
TOTAL	<u>100%</u>

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 (SAQs)

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 3, 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 Counsellor for advice. Please note that these PAXs are optional, but final marks will be affected accordingly

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. 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 thermosetting powders is dealt with in detail in:*

Polymer Powder Technology – Edited by M. Narkis & N. Rosenzweig – Wiley

OBJECTIVES

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

Section 1 – Introduction to the thermosetting process

1.1. Define the thermosetting process, comparing the types of polymers involved with thermoplastics.

1.2. Describe the cross-linking mechanism, giving important examples of reactions used in the formulation of powder coating media.

Section 2 – Powder media

2.1. Identify types of thermosetting media used to manufacture coating powders and list the properties of the five most commonly used.

2.2. Describe the types of epoxy-based systems used in powder coatings, listing their respective advantages and disadvantages.

2.3. Describe the types of polyester-based systems used in powder coatings, listing their respective advantages and disadvantages.

2.4. Describe the types of acrylic-based systems used in powder coatings, listing their respective advantages and disadvantages.

Section 3 – Factors affecting formulation

3.1. State the various stages in curing and the factors affecting the process.

3.2. List the important properties that a resin must have to be suitable as a powder coating medium.

3.3. List the important properties that a hardener must have to be suitable as a powder coating medium.

3.4. Explain stoichiometry and its importance and determine the optimum ratio in a typical example of a thermosetting resin system.

3.5. List the factors that should be considered when formulating a coating powder.

3.6. Identify some of the problems commonly associated with media, which may arise during manufacture and application, suggesting possible remedies.