The COATINGS TRAINING INSTITUTE

Study Guide

Intermediate Module 403

Raw Materials – Solvents and Additives

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Summary

Module 403, is one of a series at Intermediate level dealing with the raw materials used in surface coatings. It introduces the solvents used in coatings, and the additives or modifiers are used to control or modify the performance of coatings. Students requiring a more detailed study of additives should refer to the relevant Advanced level modules.

This module begins by defining solvents, explains how they can be classified and then goes on to describe their characteristic properties.

It then proceeds to a review of additives, starting with those used in the dispersion process of manufacture. Then, additives used to maintain product stability, after manufacture, are described, including both water- and solvent-based products. The general stability, skinning, pigment settlement, moisture absorbers and corrosion inhibitors are dealt with.

This is followed by a consideration of additives employed in the application process, including rheological and flow modifiers, conductivity controllers, anti-static agents and deodorants.

The fourth section explains the use of additives to accelerate the polymerisation of some air-drying coatings, additives used to modify the film appearance of powder coatings and also makes reference to solvent modifiers.

The final section introduces a wide range of additives that are used to modify the physical and chemical properties of the applied coating. Plasticisers, adhesion promoters, optical brighteners, lubricants and anti-scuff agents are reviewed followed by anti-fouling agents, aids to corrosion resistance and corrosion inhibitors, and finally biocides.

Structure of the module

The module training material consists of 5 sectios, 1 set of Self Assessment Questions (SAQ), I Computer Marked Assessment Questios (CMA) 1 Practical Exercise (PAX) and an End Test (TMA).

This module is designed to take about 10 hours of study. This excludes to the time taken to write up the report for the PAX.

Self-Assessment Questions (SAQ)

Are designed to enable you to check your own progress. Questions are asked as you progress through the module. You should write down your answers and then check them against the answers given in the Appendices. No marks are awarded for SAQs.

Computer Marked Assessment Questions (CMA)

Are a multi-choice question set that tests your understanding of the module. Please carry out this test before you submit any other work for marking by your tutor. These are completed online, you will need to log onto your study portal and then follow the CMA link/ instructions.

Practical Attendance Exercises (PAX)

Only a few modules contain PAX. However, we recommend that when starting any module, you look at the requirements for a PAX, to see if you anticipate any problems in carrying this out. For example, apparatus, materials, laboratory space and time. Please see Appendix 2 for details. If you have any problems, please contact your tutor or workplace mentor for alternatives.

Tutor Marked Assessment (TMA)

Is a mandatory end test question paper taken under 'closed books', fully invigilated exam conditions. These are normally held on-site with an invigilator in attendance, which is normally your workplace mentor. The student or mentor will contact Lorraine Beard, and she will arrange for the TMA and instructions to be sent, by email to the chosen invigilator, and then this is then given to the student on the day and time that has been chosen.

Marks for the module

CMA	20%
PAX	35%
TMA	45%
	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. In addition, an overall minimum mark of 50% - 64% must be achieved for a PASS to be awarded, an overall mark of 65% - 84% must be achieved for a Merit and over 85% for a Distinction.

Module Pre-requisites

These modules include references to scientific concepts relating to coatings technology. For example, those identified with an asterisk contain many references to chemical formulae and reactions. Therefore, it is a requirement that you have a scientific education, with Chemistry and Physics to at least UK Advanced Level or higher, of which you can provide evidence.

Overview of qualification levels

Persons taking these modules should be employed or have recently been employed in the coatings or a related industry.

Most intermediate students will have studied some modules at foundation level. However, students who have not studied modules at foundation level but have a scientific background and experience of the coatings industry should be able to benefit from this module.

Successful completion of six modules, including at least four at level 4 entitles a student to a full, Level 4 International Certificate in Coatings Technology (ICCT), awarded by The Coatings Training Institute. However, individual certificates are also presented if the student chooses to take less than six modules.

Module Objectives

Section 1. Solvents and Solvent Blends

Objective 1.1 Define solvents and their use in coatings
Objective 1.2 Understand the classification of solvents
Objective 1.3 Explain the characteristic properties of solvents
Objective 1.4 Understand the reason for using solvent blends

Section 2. Modifiers to the Dispersion Process and Product Stability

Objective 2.1 Explain the need for additives at the manufacturing stage including dispersing aids and foam controllers
Objective 2.2 Explain the problems of maintaining product stability
Objective 2.3 Explain the problems of skinning and the additives used to prevent this
Objective 2.4 Describe the problems of pigment settlement and additives used to minimise the problem
Objective 2.5 Discuss the use of moisture absorbers
Objective 2.6 Explain the use of 'in can' corrosion inhibitors

Section 3. Modifiers to the Application Process

Objective 3.1 Explain the need for rheological and flow additives
Objective 3.2 Explain the special need to control the conductivity of paints to be applied by electrostatic methods
Objective 3.3 Explain the need for anti-static agents in certain application methods
Objective 3.4 Explain the need for deodorants in surface coatings

Section 4. Modifiers to aid polymerization, modifiers to powder coating films, solvent modifiers

Objective 4.1 Understand modifiers used to accelerate the polymerisation process
Objective 4.2 Explain the additives used in powder coatings to create special film appearance effects
Objective 4.3 Understand the need for solvent modifiers to increase the flash point of a product

Section 5 Modifiers to Physical & Chemical Properties

Objective 5.1 Understand modifiers that influence physical & chemical properties of coatings

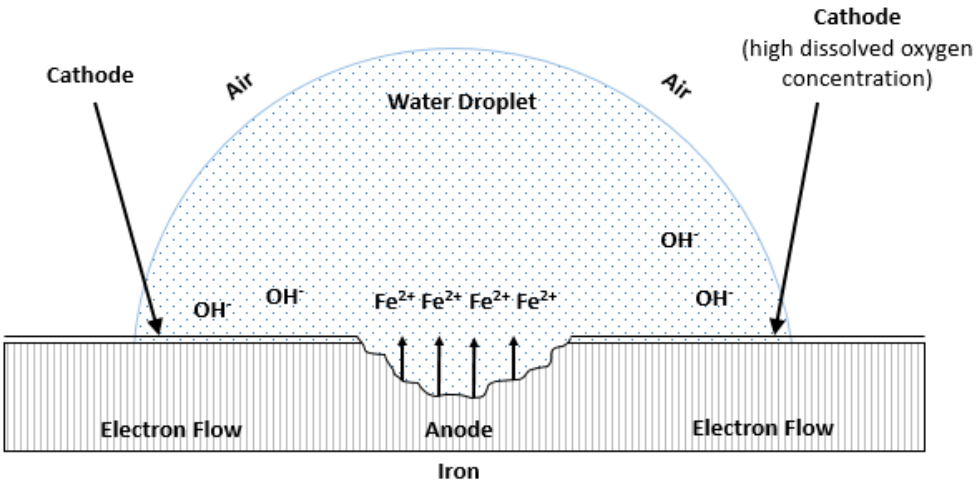
Objective 5.2 Recognise the need for modifiers that influence environmental properties

Objective 5.3 Understand fire retarders

Objective 5.4 Explain inhibitors to limit corrosion under applied coatings

STUDENT'S NOTES

Contact between two dissimilar metals may give rise to corrosion, particularly in the presence of dissolved salts. In a similar way, pitting corrosion can occur around a drop of water on any steel surface.



Anode Reaction

Inside the pit:

$Fe \longrightarrow Fe^{2+} + 2e^-$

Eventually the ferrous ions will meet the hydroxide ions formed at the cathode.

$Fe^{2+} + OH^- \longrightarrow Fe(OH)_2$

The $Fe(OH)_2$ formed may eventually be oxidized by aerial oxygen to form rust around the pit.

Cathode reaction

At the edge of the droplet:

$2H^+ = \frac{1}{2}O_2 + 2e^- \longrightarrow 2H_20$

In addition, due to the high concentration of dissolved oxygen the following reaction occurs:

$O_2 + H_20 + 4e^- \longrightarrow 4OH^-$