

# **Study Guide**

## **Module 418 – Level 4**

# **Manufacture – Flow**

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### **Summary**

Flow characteristics are of vital importance in coatings. The rheology of a formulation affects the efficiency of the dispersion process, the stability of the product and its packaging and transport.

During application, the flow has to be properly controlled to ensure that the coating is applied correctly and that the film then levels to give the desired finish.

This module expands on the introduction to the subject made in Foundation Module 204 and investigates the key elements which need to be controlled by formulators, production staff and users alike.

## **Structure of the module**

The module training material consists of 5 sections, 1 set of Self-Assessment Questions (SAQ), 1 Computer Marked Assessment Questions (CMA), 1 Assignment (ASG) and an End Test (TMA).

The module is designed to take approximately 10 hours of study. This excludes the time taken to write up your ASG.

### **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.

### **Assignment (ASG)**

The ASG are an exercise in which the student research into and reports on certain objectives. You can discuss your proposed assignment with your tutor and mentor before commencing work. You will need to write a report on the assignment, which is then sent to your tutor for marking. Please see further instructions included in the Appendix on ASG Guidance Notes. Please note that there are 2 ASG's in this module.

### **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%
ASG	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 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.

Persons taking modules at Intermediate Level should be employed or have recently been employed in the coatings or a related industry. They should have studied some science and chemistry.



## **Objectives**

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

### **Section 1 – Rheological properties**

- 1.1. Explain the terms rheology and flow
- 1.2. Explain the term surface tension

### **Section 2. Newton’s Law and Newtonian fluids**

- 2.1. Define Newton’s Law in terms of shear stress and shear strain
- 2.2. Explain the terms viscosity and Newtonian flow

### **Section 3. Non-Newtonian behaviour**

- 3.1. Draw typical graphs to illustrate the variation of apparent viscosity with time and with the rate of shear strain for a Bingham Plastic. Give an example of such a material and suggest a mechanism to explain it
- 3.2. Draw typical graphs to illustrate the variation of apparent viscosity with time and with the rate of shear strain for a pseudoplastic system having a yield value. Give one example of such a material and suggest a possible mechanism to explain it
- 3.3. Draw typical graphs to illustrate the variation of apparent viscosity with time and with the rate of shear strain for a dilatant fluid. Give one example of such a material and suggest a mechanism to explain it
- 3.4. Describe the behaviour of a thixotropic liquid under shear, illustrating your answer with graphs showing the change in apparent viscosity with time and shear strain. Give one example of a material displaying it, and suggest a mechanism to explain it

### **Section 4. Measurement of viscosity**

- 4.1. Compare experimentally, using a Brookfield Viscometer (or similar rotational viscometer,) the flow characteristics of a Newtonian and a non-Newtonian fluid and identify the type of non-Newtonian behaviour exhibited.
- 4.2. Identify the important flow characteristics influenced by viscosity, giving examples of suitable equipment for measuring each factor.

### **Section 5. Control of flow characteristics**

- 5.1. Explain the term 'secondary flow.'
- 5.2. Discuss the need for controlled flow to aid various application methods.