

**DIPLOMA IN PACKAGING
TECHNOLOGY:
PROGRAMME SPECIFICATION**

Revised February 2007

CONTENTS

	Page No
Executive Summary	1
Introduction	5
Centre Approval	5
Scheme Approval	6
Aims	6
Outcomes	7
Target Group	7
Entry Requirements	8
Level	8
Progression	8
Staffing	8
Quality Assurance	9
External Moderation	9
Programme Organisation	10
Programme Structure	10
Unit 1: The Fundamental Principles of Packaging	12
Unit 2: Packaging Materials and Components I	16
Unit 3: Packaging Materials and Components II	20
Unit 4: Packaging Processes	23
Unit 5: Managing Packaging Development	26
Key skills	29
Additional Learning Opportunities	29
Assessment	30
Certification	30
Suggested Source Material	30

EXECUTIVE SUMMARY

Introduction

The Diploma in Packaging Technology is a nationally recognised qualification for those wishing to pursue a career in the packaging industry, or for those who are already in the industry and who wish to extend their knowledge and expertise. The qualification is broad, and provides an opportunity to study the principles of packaging, packaging materials and packaging processes. Students can study for the complete qualification, or individual units, if they prefer.

The Diploma can also provide a very useful complementary qualification for those on HNC/D or degree programmes in packaging design.

Courses leading to the Diploma can be organised by providers who have gained Centre and Scheme approval by the Packaging Industry Awarding Body (PIABC). To achieve this they need to apply to PIABC and to demonstrate their ability to deliver high quality education leading to the qualification. Centres are expected to employ robust quality assurance processes, and PIABC will appoint its own moderators to ensure the effective operation of these processes, and the maintenance of standards of quality.

The Diploma in Packaging Technology aims to be a nationally recognised qualification which provides learners with a broad knowledge of the principles, materials, processes and other elements of packaging production and use. Those achieving the Diploma will be able to apply this knowledge to solving problems and making decisions associated with the technical and aesthetic performance, cost, safety and legality of packaging materials and packed products.

Candidates will normally be expected to have a minimum of 1 GCE A level and 5 GCSEs at grade A – C, including one science subject, plus the key skills of numeracy, communication and information technology, or alternatively the Certificate in Packaging. Overall, it is expected that courses leading to the qualification will take approximately 120 hours. In addition, students will be expected to carry out additional reading and other work to complete each unit.

Success in this qualification prepares students for progression in the packaging industry to a position where they can assume responsibility for packaging in a company at any point in the supply chain. Success also provides the student with an entry level qualification for the MSc in Packaging Technology at the University of Loughborough.

Course Summary

The course is divided into five units:

Unit 1 *The Fundamental Principles of Packaging*

This Unit will introduce learners to the subject of packaging by examining what packaging is used for and what it does for the product and the user, both within its broad social and economic context and its more specific functional and aesthetic context. Emphasis is placed on understanding product properties and the different and sometimes conflicting requirements and expectations at each stage of the life of the product, and thus deriving packaging properties to meet these requirements and expectations. Factors which affect the safety and legality of packed products are considered, along with ways of ensuring compliance. Assessment takes the form of a one and half hour multiple choice/short question examination.

Unit 2 *Packaging Materials and Components I*

In this Unit learners study three of the common packaging materials: glass, metals, and paper/board. For each material, the raw materials, manufacturing processes and conversion processes used for high volume packaging materials and components are studied. Material properties are discussed, with an emphasis on linking back to Unit 1 where performance properties required to meet the functions of packaging were derived. Performance throughout **all** stages is considered, including packaging line (especially material/machine interfaces), storage and distribution, display and sale, use and disposal by the final consumer. Market uses and applications, along with the influencing factors which affect current and future usage are also reviewed. Assessment takes the form of a two hour multiple choice/long question examination.

Unit 3 *Packaging Materials and Components II*

In this Unit learners study plastics as packaging materials and it follows similar lines to those described in Unit 2 above. Pack closures and the factors affecting seal integrity are also covered in this Unit, along with adhesives and the typical materials used for labels. Assessment takes for form of a two hour multiple choice/long question examination.

Unit 4 *Packaging Processes*

In this Unit participants study in detail two areas to which reference has been made in earlier Units:

- Printing and decorating processes for packaging materials.
- Packaging machinery and packaging line operations.

In both cases there is a requirement for a high level of knowledge and understanding of materials properties, as studied in Units 2 and 3. Assessment takes the form of a two hour multiple choice/long question examination.

Unit 5 *Managing Packaging Development*

This Unit builds on Units 1 - 4, and introduces participants to many of the management functions associated with the design, development, production and use of packaging materials and components. Those who take this as a stand alone unit will need to have a high level of knowledge in the areas covered by Units 1 - 4. Assessment takes for form of a 5,000 word dissertation.

In addition to the unit content there is also an opportunity throughout the programme for the key skills of communication, numeracy and IT to be developed along with broader additional learning opportunities.

INTRODUCTION

The Diploma in Packaging Technology is a nationally recognised qualification for those wishing to pursue a career in the packaging industry, or for those who are already in the industry and who wish to extend their knowledge and expertise. The qualification is broad, and provides an opportunity to study the principles of packaging, packaging materials and packaging processes.

The Diploma can also provide a very useful complementary qualification for those on HNC/D or degree programmes in packaging design, food science/technology, materials science/engineering, and logistics.

CENTRE APPROVAL

Centres wishing to offer the Diploma in Packaging Technology are required to be approved as a centre with the PIABC in advance of submitting an application for Scheme Approval. An application for Centre Approval should be made on the appropriate form. This and full details of registration policy and procedures are available from PIABC.

Centre Approval is concerned with the identification of a centre's ability to manage and deliver effectively, educational and training programmes. It is not concerned with scheme specific issues. It is usual for staff from PIABC to visit a centre as part of the approvals process.

In following the Centre Approval procedures centres are expected to provide information on the following:

1. Quality Systems
2. Human Resources
3. Learning Resources
4. Student Support
5. Inspection
6. Other General Information

Centres are required also to ensure that health and safety regulations are adhered to at all times with regard to the health and well-being of all staff and candidates. Centre health and safety policies should be sent to the Awarding Body, together with details of training available for staff and candidates.

SCHEME APPROVAL

PIABC approved centres wishing to run any or all of the Diploma in Packaging Technology must submit an application for Scheme Approval by completing the appropriate form available from PIABC. This information will include the following details:

1. Scheme of Work
2. Rationale for Course
3. Accommodation and Physical Resources
4. Human Resources
5. Internal Quality Improvement Policy
6. Course Management
7. Examination Administration
8. Progression Routes
9. Employment Links

Initially centres are given approval to offer a qualification on the basis of a written submission. Each submission may be forwarded to an external moderator for a paper review. If necessary the Moderator will make an approval visit to verify the accuracy of that submission. At this stage the external moderator may request further documentation and advise the Centre of its next course of action.

AIMS

The Diploma in Packaging Technology aims to be a nationally recognised qualification which provides learners with a broad knowledge of the principles, materials, processes and other elements of packaging production and use. Those achieving the Diploma will be able to apply this knowledge to solving problems and making decisions associated with the technical and aesthetic performance, cost, safety and legality of packaging materials and packed products.

GENERAL OUTCOMES

The general objectives are to:

1. Provide those employed in the Packaging and related industries with the skills, knowledge and understanding to underpin and enhance job experience.
2. Provide learners with a portable qualification to enable job movement throughout the industry.
3. Provide learners with a means of progression to higher level qualifications, e.g. MSc, MBA.
4. Provide employers throughout the Packaging and related industries with a firm basis for judging suitability of candidates
5. Raise the status of those employed in the Packaging and related industries.

SPECIFIC OUTCOMES

See under each Unit

TARGET GROUP

This Level 4 qualification is appropriate for those wanting to enhance their employment and progression opportunities in the packaging and related industries.

There are thus two broad target groups:

1. People currently employed in parts of the industry who want to broaden their knowledge and understanding, and take on greater levels of responsibility. Due to the diverse nature of the packaging and related industries, it is difficult to define this target group in terms of precise job functions. Typically, candidates are likely to be working at the practitioner or manager level in any of the following disciplines:

<u>Discipline</u>	<u>Type of company</u>
Technical	Packaging manufacturer Packer/filler
Technical sales/marketing	Packaging manufacturer Packaging machinery manufacturer
Quality assurance	Packaging manufacturer Packer/filler
Purchasing	Packer/filler
Engineering	Packer/filler Packaging machinery manufacturer
Design	Design Agency Packaging manufacturer Packer/filler

2. People who are not currently employed in the industry, who may be following courses in associate subject areas such as packaging design, food science/technology, materials science/engineering, and logistics, will find that this programme broadens the scope of their studies.
-

ENTRY REQUIREMENTS

Candidates will normally be expected to have a minimum of 1 GCE A level and 5 GCSEs at grade A – C, including one science subject, plus the key skills of numeracy, communication and information technology, or alternatively the Certificate in Packaging.

LEVEL

The Diploma in Packaging Technology is a Level 4 qualification.

Candidates require the skills, knowledge and understanding to show competence in applying technical, aesthetic and commercial principles to a range of complex and varying tasks.

Candidates are required to analyse problems, determine root cause, and recommend and implement effective solutions, with a substantial degree of personal responsibility and accountability.

Candidates may have direct responsibility for others, or may have responsibilities within a team.

This qualification requires the learner to understand complex elements from the packaging process, for example packaging design, materials and production methods, and how these combine in practical packaging operations. It will prepare the learner to operate as a professional packaging technologist in companies in different parts of the packaging supply chain, where they will be expected to be able to deal with new and novel problems. The qualification also prepares students to advise others about alternative appropriate solutions to packaging problems, and to identify the critical factors associated with the advice that is given.

When work for this qualification is assessed, it is important to realise that evidence will be sought which demonstrates these features.

PROGRESSION

Success in this qualification prepares students for progression in the packaging industry to a position where they can assume responsibility for packaging in a company at any point in the supply chain. Success also provides the student with an entry level qualification for the MSc in Packaging Technology at the University of Loughborough.

STAFFING

It is expected that staff involved with the delivery of the course will be appropriately qualified or experienced in packaging. The PIABC approval process requires prospective centres to provide names of the staff involved in delivery and assessment including their qualifications and relevant training/employment experience, plus staff development arrangements. Whilst these details are passed on to the External Moderator appointed by the Awarding Body, it is the Centre's responsibility to ensure tutors' qualifications are both bona fide and appropriate to the level of the qualification.

QUALITY ASSURANCE

PIABC requires that each centre has a quality assurance and enhancement procedure in respect of the programme, and a means of monitoring its implementation.

There should be a course team that is responsible for preparing an annual self-assessment of the programme and for monitoring the improvement measures resulting from this.

This self-assessment process should use evidence from different sources including:

- Candidate self-evaluation
- The views of external individuals and organisations, for example those companies sending learners
- Staff working on the course.

In addition, it is also expected that there will be an internal moderation procedure to ensure standardisation of course delivery. This will include the following elements:

- Classroom observation
- Peer review of course materials
- Moderation of any internally assessed elements

There should be a named and appropriately qualified individual (Centre Co-ordinator) who has the necessary authority, with whom the awarding body can liaise directly on all matters of management, administration and quality assurance.

EXTERNAL MODERATION

The PIABC will appoint external moderators to visit centres in order to ensure the maintenance of standards of quality. The role of the moderator includes:

- Liaison between the centre and PIABC to ensure standardisation in terms of the quality of course delivery
- Providing advice and support for the Centre in understanding and implementing the requirements of the course and the PIABC

Moderators will carry out at least one visit to each centre per year, and will formally report on the outcome of this visit to the Centre and Awarding Body. All items contained in the report will be discussed with the Centre during the visit, and any action that the Centre needs to take will be agreed at that stage.

Any visits in addition to the annual visit may incur an additional fee.

PROGRAMME ORGANISATION

It is anticipated that the qualification will require a minimum of 120 guided learning hours for satisfactory completion.

The course is made up of five units and to gain the award of Diploma in Packaging Technology, it is necessary to satisfactorily complete all five units. However, the Unit structure will enable candidates to achieve accreditation for units successfully completed, even if they do not wish, or are unable, to achieve the full award.

The organisation of the scheme is at the discretion of the Centre and will take into account the aims, aspirations and experience of the candidates.

Centres are encouraged to choose the most suitable curriculum model for their candidates. Whilst the sequential delivery of topics is a possibility and may provide the most straightforward way of determining completion of individual topics, it is may be that some degree of integration of topics will occur.

Centres must ensure that adequate arrangements are in place for supporting candidates. This could be either through separate tutorial sessions or through the use of time within structured study sessions. Centres using on-line or other forms of open learning must ensure that appropriate tutorial support is provided for candidates.

In relevant circumstances, centres are recommended to provide information and guidance to their candidates on the availability and type of employment the programme may lead to and on the progression routes available for further education and training in packaging.

PROGRAMME STRUCTURE

In designing the course, the principles of constructive alignment have been employed, i.e. the intended learning outcomes (which reflect the requirements of industry) clarify the course objectives, the assessment process is referenced to those outcomes and the learning and teaching strategy (see Guidance below) must be designed so that students learn the intended outcomes in an effective manner.

The course is divided into five units:

Unit 1

The Fundamental Principles of Packaging

Unit 2

Packaging Materials and Components I

Unit 3

Packaging Materials and Components II

Unit 4

Packaging Processes

Unit 5

Managing Packaging Development

Full details now follow for each Unit, comprising:

- Content overview
- Intended learning outcomes
- Detailed structure, with recommended guided learning hours for each section

Assessment is described separately.

Guidance on learning and teaching strategy and methods – applicable to all Units:

Packaging technology is a practical subject, based on theoretical principles. As far as possible, it is important that the course is taught by relating the underlying theory to practical examples and applications. Two factors which will help in this regard are:

- a. The use of lecturers with direct experience in the packaging and related industries. Specifically for Units 2, 3, and 4, lecturers with experience in the relevant packaging manufacturing (converter) sector are likely to offer the most appropriate level of practical knowledge. This must, of course, be balanced against a sound understanding of the theoretical principles, as anecdotal experience alone is unlikely to meet the requirements of the course.
- b. Wherever possible, the use of factory visits to packaging manufacturers, where learners can see the packaging manufacturing processes. Video/CD illustrations of processes should also be used as part of the teaching regime. A further and invaluable source of information is the Internet and there are many web sites which demonstrate important aspects of packaging manufacture. Lecturers should be encouraged to use this material, always making sure due acknowledgment is given to the source.

Those learners employed in the packaging and related industries, will come to the course with varying levels of existing knowledge and/or practical experience of some parts of the syllabus. Lecturers should utilise this, through group work and other structured interactive activities, thus encouraging the sharing of knowledge which has the potential to lead to a high level of understanding.

Unit 1

The Fundamental Principles of Packaging

Content overview:

This Unit will introduce learners to the subject of packaging by examining what packaging is used for and what it does for the product and the user, both within its broad social and economic context and its more specific functional and aesthetic context. Emphasis is placed on understanding product properties and the different and sometimes conflicting requirements and expectations at each stage of the life of the product, and thus deriving packaging properties to meet these requirements and expectations. Factors which affect the safety and legality of packed products are considered, along with ways of ensuring compliance.

Intended learning outcomes:

At the end of this Unit the learner should be able to:

1. Explain how and why packaging has developed and what is its role in modern society.
 2. Describe the structure of the packaging industry and explain the relationships between different sectors of the industry.
 3. Explain the major functions which packaging is required to fulfil and evaluate the relative importance of each function, as appropriate to the product.
 4. Examine the main spoilage mechanisms for food and drink, pharmaceuticals, toiletries and cosmetics products. From this, derive the key performance properties of packaging and the process controls needed to extend product shelf life.
 5. Design storage trials to determine shelf life and product/pack compatibility.
 6. Investigate the causes and effects of product damage in the supply chain. From this, derive the key performance properties of packaging and the process controls needed to minimise product damage.
 7. Develop test programmes to evaluate how products perform on the packaging line and in the journey from packaging line to final consumer use.
 8. Identify and investigate the impact of the key legislation (globally) which affects and influences packaging manufacture, packer/filler operations, storage and distribution, display, sale and use of packed products. Discuss how compliance can be demonstrated.
 9. Discuss the factors which affect the impact of packaging on the environment and explain how environmental impact can be evaluated. Compare methods of handling packaging waste.
 10. Explain and evaluate the impact of the European Directive on Packaging and Packaging Waste on packaging manufacturers, packer/fillers and sellers of packaged goods.
-

Detailed structure:

Unit 1 is made up of:

1A *Role and functions of packaging (12 hours)*

- Packaging usage worldwide: how packaging has developed in line with societal changes, material and process developments. The development, structure and inter-dependence of the various parts of the packaging industry, including packaging manufacturers, packer/ fillers, packaging machinery manufacturers, designers, retailers, the final consumer and packaging waste operators.
- The functions of packaging: how packaging is used as a means of containing, protecting and preserving the product. Defining the product in terms of its nature, critical properties and value. Identifying causes of contamination. The causes and effects of biotic and abiotic spoilage, understanding spoilage mechanisms in food and drink, pharmaceuticals, toiletries and cosmetics, and how spoilage can be reduced by appropriate choice of process and packaging, along with control of storage and handling conditions. Estimating shelf life and setting up storage trials, determining product/pack compatibility.
- Packaging in its role of providing convenience in the safe handling and use of the product, on the packaging line (the importance of packaging material/machine compatibility, especially for high speed, fully automated processes) in storage and distribution, display, consumer use and disposal. The need for tamper evident packaging and how this can be achieved.
- Packaging as a way of providing information about the product, both in the storage and distribution chain, and, importantly, during display, sale and use by the final consumer. Consideration of the different types of information required: simple identification, assembly and usage instructions, legal, advisory, promotional information, use of bar codes. Requirement for clarity and legibility by human eye or electronic data capture systems.
- Packaging as a means of selling the product, as the first impact on the purchaser, especially in the retail environment. How packaging attracts the purchaser's attention: use of colour, graphics, shape, size and texture.
- Packaging as a means of delivering cost effective solutions for moving goods from production to the final user. Total pack cost in relation to product value and market position, and the demands and expectations of the supply chain and the consumer.

1B *Hazards of the supply chain (6 hours)*

- Understanding the properties of the product, the hazards of the supply chain, and the use of packaging to provide the product protection required.
 - Mapping the journey from packaging line to consumer. Complexity of journey map for multiple handling and extended distribution systems, e.g. mail order, Internet sales, worldwide sourcing. Extending the journey map back up the supply chain, taking account of packaging manufacturing processes and the storage and distribution of packaging materials and components to the packer/filler operation.
-

- Identifying the main hazards, their causes and effects, which may compromise the quality, hygiene, safety and legality of the packed product. Measuring and monitoring the hazards in terms of likely range of drop height, vibration frequency, compression load, temperature and humidity, contamination. Simulating journey hazards in the laboratory and carrying out actual transit trials. Setting standards.
- Defining product fragility and identifying damage levels, e.g. breakage, scratching, scuffing, of both product and pack. Quantifying fragility and acceptable damage levels.
- Reducing damage levels by appropriate choice of packaging materials and process controls. Properties and uses of protective packaging materials: comparisons of different types of cushioning, calculating cushioning requirements. Calculating stacking factors for loads under compression. Packaging materials to provide protection against moisture ingress/loss.
- Identifying, investigating and reducing the effects of other causes of damage in the supply chain: product pilferage and tampering, contamination due to poor hygiene practices and infestation.
- The role of personnel training and monitoring in reducing damage levels.

1C Legislation in packaging (6 hours)

- The role of EC legislation and the relationship between EC and local legislation in the countries of Europe. Overview of global legislative requirements.
 - Sources of information on legislation and the role of government agencies and trade associations. Differentiating between what is legally required and what is regarded as good practice within an industry or company.
 - Identifying legislation relevant to packaging: product quality and health hazard, protection of the workforce, honesty in trade and protection of the environment.
 - Linking this legislation to the topics studied in 1A and 1B, and determining the legal consequences of failure in these areas, e.g. failing to provide the appropriate level of preservation, failing to provide the required information, or delivering unsafe packs into the market. Ensuring and managing compliance throughout the supply chain.
 - The principle of 'due diligence' and its application to packaging materials and processes. Consequences of non-compliance.
-

1D *Impact of packaging on the environment (6 hours)*

- Placing the environmental impact of packaging in context with its role in society and its economic role in conserving product resources and value. Developing environmentally responsible packaging. Evaluating environmental impact and the concept of life cycle analysis for a total packed product. Consideration of product and pack waste.
- Packaging in the industrial, commercial and domestic waste stream. Comparisons of methods of handling, reuse, recovery and recycling as applied to paper and board, plastics, metals, glass and wooden packaging. Environmental effects, cost and potential uses.
- EC Directive 94/62 on packaging and packaging waste: overview of implementation in Europe. Specific requirements for the United Kingdom: effect of the Packaging Waste (Producer Responsibility Obligations) Regulations and the Packaging
- (Essential Requirements) Regulations on the packaging supply chain. Ensuring and managing compliance and consequences of non-compliance.

Total guided learning hours - 30

Unit 2

Packaging Materials and Components I

Content overview:

In this Unit learners study three of the common packaging materials: glass, metals, and paper/board. For each material, the raw materials, manufacturing processes and conversion processes used for high volume packaging materials and components are studied. Material properties are discussed, with an emphasis on linking back to Unit 1 where performance properties required to meet the functions of packaging were derived. Performance throughout **all** stages is considered, including packaging line (especially material/machine interfaces), storage and distribution, display and sale, use and disposal by the final consumer. Market uses and applications, along with the influencing factors which affect current and future usage are also reviewed.

Intended learning outcomes:

At the end of this Unit the learner should be able to:

1. Outline how and why glass, steel, aluminium and paper/board (including corrugated board) have developed as packaging materials.
 2. In the manufacture of glass containers, identify the main raw materials used and describe how glass is made and converted into bottles, jars and other components, e.g. vials and ampoules. Compare the different conversion processes in terms of cost and component properties and performance.
 3. Discuss the uses of glass in packaging and the properties which encourage and/or limit such use, including factors such as cost and environmental impact. Explain and evaluate how the selection of raw materials and/or the manufacturing processes influence these properties and factors.
 4. Write specifications* for glass containers.
 5. In the manufacture of rigid metal packaging, identify the main materials used and describe how metal cans, boxes, tubes and closures are made. Compare the different materials and processes in terms of cost and component properties and performance.
 6. In the manufacture of flexible metal packaging (aluminium foil) identify the main raw material used and describe how aluminium foil is made.
 7. Discuss the uses of metals in packaging and the properties which encourage and/or limit such use, including factors such as cost and environmental impact. Explain and evaluate how the selection of raw materials and/or the manufacture processes influence these properties and factors.
 8. Write specifications* for a metal components.
 9. In the manufacture of paper and board packaging, identify the main raw materials used and describe how paper and board are made and converted into bags, cartons and other components. Compare the different types of paper and board in terms of cost and material properties and performance.
 10. In the manufacture of corrugated board, identify the main raw materials used and describe how corrugated board is made and converted into cases, trays and other
-

components. Compare the different types of corrugated board in terms of cost and material properties and performance.

11. Discuss the uses of paper and board in packaging and the properties that encourage and/or limit such use, including factors such as cost and environmental impact. Explain and evaluate how the selection of raw materials and/or the manufacture processes influence these properties and factors.
12. Write specification* for paper/board components.
13. Compare the three packaging materials studied and make an informed and justified selection of the most appropriate material for a range of uses.

Note: Manufacturing and conversion processes include all aspects from the availability of raw materials to the production of acceptable quality materials and components ready for despatch, to meet the requirements of the packer filler operation or the next point in the supply chain. The learner should be able to discuss the typical defects associated with each process, which may compromise the quality, hygiene, safety and legality of the final packed product, and what steps must be taken to avoid/reduce the incidence of such defects.

**Specifications should include all information needed to clearly state the requirements of the packaging materials and components. An outline specification sheet is provided with the course materials.*

Detailed structure:

Unit 2 is made up of:

2A Glass packaging (5 hours)

- Properties of glass in packaging: advantages and disadvantages. Uses in different markets, threats and opportunities. Material and process developments.
 - Manufacture of glass packaging from raw materials to finished components: melting of raw materials, refining, gob forming, tooling requirements, blow and blow process, press and blow process, narrow neck press and blow process, tubular glass forming.
 - Raw material variations for different glass types, Type I, II, III. Annealing process and why it is used. Coating processes, materials used for coating, why coatings are used. Quality aspects, typical defects, on-line and off-line inspection processes. Packing, labelling and traceability of batches.
 - Outline of decoration processes available (studied in detail in Unit 4)
 - Environmental overview, reuse and recycling of glass containers (link back to Unit 1)
-

2B *Rigid metal packaging (5 hours)*

- Properties of steel and aluminium in rigid metal packaging: advantages and disadvantages. Uses in different markets, threats and opportunities. Material and process developments.
- How corrosion is managed: tin-plating, chromium/chromium oxide coating, polymer and lacquer coatings. Types of coatings and their uses. Product/pack compatibility and product shelf life.
- Manufacture of rigid metal components. Built-up construction: side seam fabrication, comparison of welding, mechanical locking and adhesive sealing. Draw and redraw, draw and wall ironing, impact extrusion. Starting materials, forming processes, flanging, beading, finishing. Manufacture of can ends: starting materials, forming processes, sealing compounds, finishing. Application of can ends: double seam and hermetic seal for long life preservation. Basics of retorting process (link back to Unit 1, preservation processes). Quality aspects, typical defects, on-line and off-line inspection processes. Packing, labelling and traceability of batches.
- Outline of decoration processes available (studied in detail in Unit 4)
- Environmental overview, reuse and recycling of rigid metal containers (link back to Unit 1)

2C *Aluminium foil packaging (3 hours)*

- Properties of aluminium foil in semi-flexible and flexible packaging: advantages and disadvantages. Uses in different markets, threats and opportunities. Challenge from metallised materials. Material and process developments.
- Extraction of aluminium from bauxite, rolling and annealing processes, temper and effects on performance, production of aluminium foil. Quality aspects, typical defects, on-line and off-line inspection processes.
- Overview of foil container production.
- Overview of decoration processes available (studied in detail in Unit 4)
- Environmental overview, recycling of aluminium foil (link back to Unit 1)

2D *Paper and board packaging (5 hours)*

- Properties of paper and board in packaging: advantages and disadvantages. Uses in different markets, threats and opportunities. Choice of suitable board types. Material and process developments.
 - Sources of fibre, fibre selection and properties, including secondary fibre, sources and properties. Pulping processes: mechanical, chemical, combination processes. Fibre treatments and effect of treatment levels on performance. Bleaching, colouring and final pulp preparation for paper and board making.
 - Fourdrinier and VAT processes, single and multi-ply forming, wet end, dry end and reeling and finishing processes. Quality aspects, typical defects, on-line and off-line inspection processes. Packing, labelling and traceability of batches.
-

- Coating processes: clay coating, wax and polymer coating, on-line and off-line operations.
- Outline of decoration processes available (studied in detail in Unit 4)
- Basics of bag and sack making, important paper properties, use of multi-ply structures.
- Folding cartons: board selection, design and development, production processes: cutting and creasing, finishing and gluing, packing, labelling and traceability of batches. On-line and off-line inspection processes.
- Basics of carded pack manufacturing: blister packs, skin packaging.
- Basics of container making: spiral and convolute winding.
- Overview of rigid box making.
- Environmental overview, recycling of paper and board (link back to Unit 1)

2E Corrugated board packaging (4 hours)

- Properties of corrugated board in packaging: advantages and disadvantages. Uses in different markets, threats and opportunities. Material and process developments.
- Liner and adhesive selection for specific performance. Use of recycled fibres and performance of materials.
- Different flutes types available: properties and uses. Single, double and triple wall materials: description, typical flutes used, properties and uses.
- Manufacture of corrugated board from selection of liners and adhesives. On-line and off-line inspection processes.
- Conversion into cases, trays, fitments etc. Die cutting/slotting, folding/gluing, finishing, packing, labelling and traceability of batches.
- Outline of decoration processes available (studied in detail in Unit 4)
- On-line and off-line inspection processes.
- Choice of case/tray style and production process. FEFCO nomenclature.

2F Material summary and comparisons (3 hours)

- Origins of glass, metal and paper/board packaging and relationship to developments in product preservation and protection, linked to changes in society. Current market usages and trends.
- Performance comparisons, application to specific end uses.

Total guided learning hours - 25

Unit 3

Packaging Materials and Components II

Content overview:

In this Unit learners study plastics as packaging materials. The properties and uses of the common packaging plastics are investigated, along with ways in which their properties can be modified to broaden their range of performance and uses. Material properties are linked back to Unit 1 where performance properties required to meet the functions of packaging were derived. Performance throughout **all** stages is considered, including packaging line (especially material/machine interfaces), storage and distribution, display and sale, use and disposal by the final consumer. Market uses and applications, along with the influencing factors which affect current and future usage are also reviewed. Manufacturing processes for plastics materials and components. Pack closures and the factors affecting seal integrity are also covered in this Unit, along with adhesives and the typical materials used for labels.

Intended learning outcomes:

At the end of this Unit the learner should be able to:

1. Outline why and how plastics have developed as packaging materials.
 2. Explain the basic principles of polymer chemistry.
 3. Discuss the uses of the common packaging plastics in packaging and the properties which encourage and/or limit such use, including factors such as cost and environmental impact. Explain and evaluate how the selection of materials and/or the manufacture processes influence these properties and factors.
 4. Discuss the ways in which these materials can be modified and improved.
 5. In the manufacture of plastics films and components, identify the typical materials used and describe how plastics resins are converted into films, bottles, jars, tubs, pots, compacts, boxes, closures, trays, and other components. Compare the different conversion processes in terms of cost and component properties and performance.
 6. Write specifications* for typical plastic packaging materials and components.
 7. Compare plastics, glass, metal and paper/board packaging materials and make an informed and justified selection of the most appropriate material for a range of uses.
 8. Describe the various ways in which packs are closed and for each, discuss the factors which influence seal efficiency and integrity.
 9. Discuss how closure efficiency and integrity contribute to the functions of packaging and where conflict with consumer convenience (e.g. easy opening) may arise (link back to Unit 1).
 10. Describe the raw materials used, properties and applications of the common packaging adhesives and select appropriate adhesives for a range of uses.
 11. Explain the main theories of adhesion, draw up the requirements for a good bond and explain how to test for bond strength as part of a production line operation.
 12. Outline how and why labels have developed as packaging components.
-

13. Describe the different types of labels available and the common materials used. Compare the performance of different label and material types.

14. Select the right label for a given end use.

15. Write specifications* for adhesives and labels.

Note: Manufacturing and conversion processes include all aspects from the availability of raw materials to the production of acceptable quality materials and components ready for despatch, to meet the requirements of the packer filler operation or the next point in the supply chain. The learner should be able to discuss the typical defects associated with each process, which may compromise the quality, hygiene, safety and legality of the final packed product, and what steps must be taken to avoid/reduce the incidence of such defects.

**Specifications should include all information needed to clearly state the requirements of the packaging materials and components. An outline specification sheet is provided with the course materials.*

Detailed structure:

Unit 3 is made up of:

3A *Basics of polymer chemistry (3 hours)*

Polymers and plastics. Basic structures.

What influences the way plastic perform: thermoset and thermoplastic materials, homopolymers and copolymers, chain structure and molecular arrangement, polymerisation and the role of initiators.

3B *Plastics properties (7 hours)*

- Market overview.
 - The common packaging plastics: polyethylene family, polypropylene, polystyrene, polyvinyl chloride, polyethylene terephthalate. Starting materials and basic structures.
 - Properties and uses, both rigid and flexible where applicable, advantages and disadvantages. Uses in different markets, threats and opportunities.
 - Other plastics used in packaging: polyvinylidene chloride, Ionomers, nylon, polyethylene naphthalate, styrene copolymers, polycarbonate, ethylene vinyl acetate, ethylene vinyl alcohol, fluoropolymers, thermoplastic elastomers, cyclic olefin copolymers, liquid crystal polymers, polyketones, cellulose film.
 - Material and process developments. Improvement of properties: orientation, combining materials, coating, metallising.
-

3C *Plastics manufacturing processes (6 hours)*

- Manufacture of plastics packaging from raw materials to finished components: cast and blown film extrusion, injection moulding, extrusion blow moulding, injection blow moulding, injection stretch blow moulding, thermoforming and laminating.
- Quality aspects, typical defects, on-line and off-line inspection processes. Packing, labelling and traceability of batches.
- Overview of decoration processes available (studied in detail in Unit 4)
- Environmental impact of plastics and recycling (link back to Unit 1)

3D *Closures (3 hours)*

- Pack closure types: folded, glued, stitched, mechanical, heat sealed. Examples of each, materials used (link back to Unit 2 where appropriate, e.g. metal closures), identification of important material properties for effective seal.
- Evaluating closure performance: destructive and non-destructive testing, development testing, on-line and off-line testing during the packaging operation. Trouble shooting closure problems.
- Special closure applications: child resistance, tamper evidence, measuring and dispensing features. Designing, specifying, evaluating performance.

3E *Adhesives (3 hours)*

- Theories of adhesion: mechanical, specific/chemical, diffusion.
- Basic definitions: tack, open time, setting time, viscosity, solids content.
- Adhesive types: starch and derivatives, emulsions (e.g. PVA), casein, cold seal, acrylic, curing adhesives, pressure sensitives, hotmelts. Raw materials, performance properties, uses. Comparisons of performance and cost.
- Adhesive application methods.
- Factors affecting bond strength, testing bond strength, trouble shooting adhesive problems.

3F *Labels (3 hours)*

- Market overview: development of adhesives and reason for use, threats and opportunities. Material and process developments.
- Label types: ungummed or wet glue, self adhesive or pressure sensitive, in-mould labels and sleeves. Advantages and disadvantages, common uses.
- Materials, important material properties for each label type.
- Designing, developing and specifying.

Total guided learning hours - 25

Unit 4 **Packaging Processes**

Content overview:

In this Unit participants study in detail two areas to which reference has been made in earlier Units:

1. Printing and decorating processes for packaging materials.
2. Packaging machinery and packaging line operations.

In both cases there is a requirement for a high level of knowledge and understanding of materials properties, as studied in Units 2 and 3.

Intended learning outcomes:

At the end of this Unit the learner should be able to:

1. Define colour and explain what affects the way we see colour and how colours are achieved in printing.
 2. Set out the steps in the process by which initial graphic design concepts are transformed into printed packaging materials.
 3. Describe the main printing and decorating processes used in packaging, and discuss the advantages and disadvantages of each process. Select the most appropriate process for a range of packaging materials and components.
 4. Discuss each of the factors which need to be considered when selecting packaging machinery.
 5. Map out a packaging line, from delivery of components to removal of finished stock, showing each sequential station in the line. Describe the key operations at each station and identify the product properties and the critical material/machine interfaces which will affect line performance and quality of finished goods.
 6. Explain how material properties affect machine performance and vice versa, and relate these explanations back to the requirements for material and machine specifications (link back to Units 2 and 3).
 7. Calculate line efficiency from given data on individual equipment speeds and propose how line efficiency may be improved.
 8. For a packaging line, evaluate the potential risks to the quality, hygiene, safety and legality of the final packed product, and explain how these risks can be minimised.
 9. Describe examples of on-line and off-line inspection and evaluate the advantages and disadvantages of each.
 10. Differentiate between on-line and off-line support on the packaging line and draw up the key responsibilities of each.
-

Detailed structure:

Unit 4 is made up of:

4A *Printing for packaging (9 hours)*

- Basics of physics of colour: seeing colour and the relationship between the source of light, the object and the observer, white light and the spectrum of wavelengths, addition and subtraction of colour, primary and secondary colours.
- Colour printing: use of CMYK, juxtaposition of dots, dot size and print quality, screen angles, limitations of CMYK, Hexachrome™, use of special colours.
- Print preparation processes: artwork and copy development, scanning, image assembly and setting, plate making. Developments in pre-press operations, advantages and limitations.
- Approval processes: proofing options, limitations of proofs, copy checking, image assembly check, setting approved standards and sign off procedures.
- Printing processes: letterpress, dry offset letterpress, flexographic, gravure, lithographic, screen, tampo, digital. For each process: control of substrate, plate type, ink type, ink transfer, drying, setting standards, maintaining colour consistency.
- Advantages and disadvantages, applications and pack types. Process developments.
- Other processes: varnishing, lacquering, hot and cold foil blocking, embossing, heat transfer printing, ceramic decals. Advantages and disadvantages, applications and pack types. Process developments.
- Specifying requirements, quality aspects, typical defects, on-line and off-line inspection processes. Packing, labelling and traceability of batches.

4B *Packaging machinery (8 hours)*

- Basics of operation of:
 - Fillers (solids, liquids, pastes)
 - Cappers (screw thread, ROPP, induction seal, push fit etc. - link back to Unit 3)
 - Labellers (wet glue, self adhesive, sleeves, neck collars)
 - Cartonners (horizontal and vertical feed, glued end, tuck flap, auto-erect etc.)
 - End of line activities: cases, trays, shrink wrapping, banding, palletising, stretch wrapping etc.
 - Form, fill and seal operations: vertical, horizontal flow wrappers, sachet forming.
 - Miscellaneous: twist wrapping, bunch wrapping, roll wrapping, adding inserts etc.
 - Coding and traceability
 - For each operation, critical material performance requirements, material/machine interfaces and tolerances allowed.
-

4C Packaging line operations (8 hours)

- Specifying requirements, considerations for line design, capital investment, timescale, manning levels, support activities required.
- Cleaning, hygiene, safety, (link back to Unit a for legal aspects) hazard and risk analysis.
- Line efficiency, maximising line speed and efficiency, measuring performance, key performance indicators.
- Quality aspects: on line automatic inspection, off line inspection.
- Maintenance planning
- Personnel training
- Problem solving on the packaging line

Total guided learning hours - 25

Unit 5

Managing Packaging Development

Content overview:

This Unit builds on Units 1-4, and introduces participants to many of the management functions associated with the design, development, production and use of packaging materials and components. Those who take this as a stand alone unit, will need to have a high level of knowledge in the areas covered by Units 1-4.

Intended learning outcomes:

At the end of this Unit the learner should be able to:

1. Draw up the factors which affect the finished cost and the selling price of a packed product and explain and evaluate what influences these factors.
 2. Describe the structure of the packaging chain, from raw materials to sellers of finished packed products. Explain the relationships between the different sectors and how these may affect cost. (Link back to Unit 1)
 3. Define "quality" and discuss how different quality systems operate.
 4. Write packaging material and finished goods specifications (link back to Units 2, 3 and 4) and explain how the specification content is agreed and why it is required.
 5. Draw up quality checklists for incoming goods, work in progress and finished goods (both packaging materials/components and packed products).
 6. Explain the basics of the function of Marketing and its interaction with Packaging.
 7. Discuss the ways in which market research can be carried out and compare the different types of data obtained.
 8. Explain what is meant by a brand and evaluate how packaging contributes to the objectives of branding.
 9. Evaluate the importance of both the functional (i.e. structural or technical) and graphic design of a pack.
 10. Draw up a Packaging Brief.
 11. Describe in detail the steps in the packaging development process required to effect a change to packaging specifications.
 12. Explain the responsibilities and interaction of the various disciplines involved in the process.
-

Detailed structure:

Unit 5 is made up of:

5A Commercial aspects of packaging (3 hours)

- Income and expenditure, fixed and variable costs, break-even, profit and selling price
- Inventory control, factors affecting stock levels, integration in the supply chain, supplier management.
- Market factors, raw material and packaging material supply and demand. Key players, impact of mergers and acquisitions. Developments.

5B Quality aspects of packaging (6 hours)

- Quality assurance and quality control, defining 'fit for purpose'
- Quality systems, operation in practice
- Assessing risk, drawing up agreed test programmes and procedures.
- AQLs, critical, major and minor defects
- Specifications and standards
- Supplier audits and development
- Legal aspects and the defence of 'due diligence' (link back to Unit 1)

5C Marketing (3 hours)

- Defining marketing and marketing responsibilities, relationship with packaging
- Branding and the impact of packaging, requirement for consistency of communication
- Market research methods and types of data available
- Defining customer needs

5D Pack design and development (3 hours)

- Graphic and functional design and the functions of packaging (link back to Unit 1)
 - Information needed to develop a new pack, change an existing pack – drawing up the packaging brief
 - Stages in the packaging development process: defining requirements, agreeing levels of responsibility, decision-making
 - Sources of information, time scales, agreeing deadlines, building in time for material and pack testing
-

- Test procedures including machine trials (link back to Units 2, 3 and 4)
- Managing the process, evaluating the finished pack, agreeing standards

Total guided learning hours - 15

KEY SKILLS

There are many opportunities for the development of key skills throughout this programme. The table below shows sections of each unit where this is the case. (NB this is indicative only)

	Application of Number	Communication	Information Technology
Unit 1: Fundamental Principles of Packaging	1A, 1B,	1A,	
Unit 2: Packaging Materials and Components I			2A
Unit 3: Packaging Materials and Components II	3A		3C
Unit 4: Packaging Processes	4A, 4C	4A	4B, 4C,
Unit 5: Managing Packaging Development	5A,	5B	5C

ADDITIONAL LEARNING OPPORTUNITIES

This programme also provides opportunities to contribute to an understanding of a range of other issues. The table below provides examples of where these opportunities are. (NB this is indicative only)

	Spiritual, moral, ethical, social or cultural issues	Environmental, health and safety, and European considerations
Unit 1: Fundamental Principles of Packaging	1A,	1A, 1B, 1C, 1D
Unit 2: Packaging Materials and Components I	2F	2A, 2B, 2C, 2D,
Unit 3: Packaging Materials and Components II	3D	3C
Unit 4: Packaging Processes	4C	4C
Unit 5: Managing Packaging Development	5A, 5C	5B

ASSESSMENT

The Units will be assessed as follows:

Unit Assessment

- | | |
|---|---|
| 1 | 1½ hour written examination, mainly multiple choice and short-answer format |
| 2 | 2 hour written examination, combination of multiple choice and long-answer format |
| 3 | 2 hour written examination, combination of multiple choice and long-answer format |
| 4 | 2 hour written examination, combination of multiple choice and long-answer format |
| 5 | Written project (5000 words) |

Successful candidates will be awarded a “Pass”, and they will be informed of their marked score for each unit, as a percentage. All units contribute equally to achievement of the Diploma.

CERTIFICATION

Diploma in Packaging Technology: The full award certificate is available to candidates who successfully complete all the units.

Unit Certification: Unit certification is available to candidates who successfully complete full individual units, but who do not wish to complete the full award.

SUGGESTED SOURCE MATERIAL

A comprehensive list of source materials and references that may be used to support learning for the Diploma in Packaging Technology is available from PIABC.
