Unit 137: Rubber Products and Specialist Elastomers

Unit code: H/602/3462

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

The unit enables learners to gain a knowledge of specialist rubbers and the preparation, properties and application of rubber solutions. Learners will investigate latex technology and the preparation of latex mixes and products. Learners will also investigate the design, manufacture and selection of rubber products.

Unit introduction

This unit builds on the concepts of rubber technology and provides an opportunity to develop learners' knowledge of the classification, properties and applications of rubbers, latex and rubber solutions. They will learn why certain rubbers are used for particular specialist applications. A knowledge and use of health and safety during rubber product production is also required, especially in the use of different solvents. Learners will develop knowledge and skills in investigating latex mix design and latex product manufacture. Learners will also gain an understanding of rubber solution manufacture and use, and the properties and applications of specialist rubbers. The unit provides learners with opportunities to develop their skills through practical investigation.

Learning outcomes

On completion of this unit a learner should:

1 Know the classification, properties and applications of specialist rubbers

2 Be able to investigate latex technology and the preparation of latex mixes and products

3 Understand the preparation, properties and application of rubber solutions

4 Be able to investigate the design, manufacture and material selection for a range of rubber products.

Unit content

1 Know the classification, properties and applications of specialist rubbers

Butadiene rubber: grading systems; processing and vulcanisate properties; cost; applications

Isoprene rubber: grading systems; processing and vulcanisate properties; cost; applications

Silicone rubber: grading systems; processing and vulcanisate properties; cost; applications

Fluorocarbon rubber: grading systems; processing and vulcanisate properties; cost; applications

Acrylic rubber: grading systems; processing and vulcanisate properties; cost; applications

Polyurethane rubber: grading systems; processing and vulcanisate properties; cost; applications

Epichlorohydrin rubber: grading systems; processing and vulcanisate properties; cost; applications

Chlorosulfonated polyethene rubber: grading systems; processing and vulcanisate properties; cost; applications

Polysulfide rubber: grading systems; processing and vulcanisate properties; cost; applications

Health and safety: rubber production; use of solvents

2 Be able to investigate latex technology and the preparation of latex mixes and products

Latex concepts: stability; preservation; concentration; coagulation; gellation; flocculation

Latex additives: fillers; cross-linking agents; antidegradants; plasticisers; foaming agents; surfactants; preparation of dispersions; emulsions; solutions

Latex products: design; foam (manufacture, testing), cast and dipped products

3 Understand the preparation, properties and application of rubber solutions

Solvent: factors affecting choice; toxicity; health and safety

Non-vulcanising: manufacture; properties; applications

Vulcanising: manufacture; properties; applications

Room temperature vulcanising: manufacture; properties; applications

Spreading: machine design; processing conditions; solvent recovery; safety

Dipping: formers; process conditions; properties; safety

4 Be able to investigate the design, manufacture and material selection for a range of rubber products

Tyres: design; manufacture; material selection; test philosophy

Belting: design; manufacture; material selection; test philosophy

Hose: design; manufacture; material selection; test philosophy

Playballs/inflatables: design; manufacture; material selection; test philosophy

Footwear: design; manufacture; material selection; test philosophy

Cables: design; manufacture; material selection; test philosophy

Rubber/metal bonded: design; manufacture; material selection; test philosophy

Cellular: design; manufacture; material selection; test philosophy

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the classification of specialist rubbers [RL6]	**M1** discuss the health and safety aspects of producing rubber and rubber products	**D1** evaluate the choice of rubber for different applications
P2 describe the properties of specialist rubbers [RL6]		
P3 describe the applications of specialist rubbers [RL6]		
P4 safely carry out investigations into the basic concepts of latex technology, including the preparation of latex mixes and products working practices [IE1, IE2, IE4, TW1, TW2, TW3, SM3, CT1]	**M2** select the most appropriate technique for the production of latex additives	**D2** compare and contrast the use of latex and rubber solutions in competing products
P5 explain the preparation of rubber solutions [RL6]	**M3** justify the choice of solvents used in the production of rubber solutions for particular applications	**D3** evaluate the production costs of alternative manufacturing methods for different rubber products
P6 explain the properties of rubber solutions [RL6]		
P7 explain the application of rubber solutions [RL6]		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 safely carry out investigations into the design, manufacture and material selection for different rubber products working practices. [IE1, IE2, IE4, TW1, TW2, TW3, SM3, CT1]	**M4** compare the test philosophy for different rubber products.	**D4** evaluate the accuracy and effectiveness of the test philosophy for different rubber products.

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators

Essential guidance for tutors

Delivery

The concepts covered by this unit should be delivered through a programme of tuition and practical work in the laboratory. Delivery should be based on a well-structured programme of practical exercises to develop learners' skills and generate the evidence necessary to meet the unit assessment and grading criteria. Learners should build on the concepts covered in *Unit 45: Basic Polymer Technology* and *Unit 50: Rubber Technology*.

If it is appropriate to use facilities other than those in the centre (for example, facilities on employers or university premises), arrangements to use such off-site facilities should ensure the necessary formative activities can be undertaken; one-off use of equipment will not meet the outcomes of this unit.

Health and safety should be a recurring theme throughout the delivery and assessment of this unit. Learners must be taught the nature of hazards and where to find appropriate information on them. Learners are not 'competent persons' under the COSHH regulations; they should not, therefore, be expected to carry out full risk analyses for practical work to be undertaken.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to unit.
Recap on what was learnt in the rubber technology unit.
Formal input: classification of specialist rubbers.
Demonstration showing different types of specialist rubbers, properties, their costs and applications.
Formal input: processing and health and safety issues.
Learners compare costs of specialist rubber products.
Research on specialist rubbers via the internet.
Assignment 1: Classification, Properties and Applications (P1, P2, P3, M1, D1)
Formal input: latex concepts including stability, concentration etc.
Learners investigate different latex additives.
Formal input: latex mix designs and products.
Learners investigate and formulate different latex mix designs.
Formal input: foams, cast and dipped products.
Formative practical investigations.
Assignment 2: Latex Mixes and Products (P4, M2, D2)
Formal input: introduction to rubber solutions.

Topic and suggested assignments/activities and/assessment
Demonstration of preparation and properties of rubber solutions.
Formal input: choice of solvents and health and safety aspects.
Formal input: spreading and dipping and health and safety aspects.
Formative assignment on rubbers solutions – learner case studies.
Assignment 3: Rubber Solutions (P5, P6, P7, M3, D3).
Formal input: range of rubber products –their design, manufacture and material selection.
Learners investigate a range of rubber products.
Learners investigate test philosophy on rubbers for example creep, friction, wear etc.
Assignment 4: Range of Specialist Rubber Products (P8, M4, D4)
Review of unit and results of assessment.

Assessment

Learners could produce laboratory reports as evidence towards meeting the assessment and grading criteria. Alternatively, learner presentations, supported by assessor witness testimony, would also form a suitable assessment method. Tutors should observe learners undertaking practical activities and clearly record assessment decisions using an appropriate assessor's observation record, retained for audit purposes.

Safety requirements must be applied to all activities. Learners must work safely and accurately within supplied methods; this must be applied rigorously to all activities.

For the pass assessment criteria, learners need to describe the preparation, properties and applications of specialist rubbers and explain the preparation, properties and application of rubber solutions. Delivery of the unit should be based on the development of skills in industrially relevant methods to meet these assessment criteria. They need to select different rubber products for their applications and investigate why they have been selected using their test philosophy.

For the merit criteria, learners need to investigate the process of producing rubber and rubber products. This requires delivery of the underlying principles, which may be introduced before or during the practical work, but should be emphasised throughout the formative programme preceding assessed exercises.

For the distinction criteria, learners need to adopt a more evaluative approach to the production of rubber and rubber products, including the use of rubber, alternative manufacturing methods and knowledge of competing products. It may be appropriate to focus on one activity in detail as a group exercise. Thereafter, these activities may be left to independent study, with appropriate guidance from tutors. If group work is undertaken, tutors must ensure that each learner individually produces sufficient evidence to meet the assessment and grading criteria and that assessment decisions are clearly recorded using an appropriate observation sheet.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1, D1	Classification, Properties and Applications	The writer for a specialist rubber magazine is producing an article on specialist rubbers.	Article. Table. Leaflet.
P4, M2, D2	Latex Mixes and Products	The specialist rubber technologist has been requested to investigate and report on latex mixes and products.	Report.
P5, P6, P7, M3, D3	Rubber Solutions	The rubber manufacturing plant manager has been requested to report on aspects of the production of rubber solutions.	Report.
P8, M4, D4	Range of Specialist Rubber Products	A specialist rubber retail company wants to produce a catalogue on its range of specialist rubber products.	Catalogue. Tables.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Applied Science sector suite. This unit has particular links with the following unit titles in the BTEC Applied Science suite:

Level 2	Level 3
Chemistry and Our Earth	Basic Polymer Technology
Applications of Chemical Substances	Plastics Processing
	Rubber Technology
	Plastics Materials
	Polymer Process Engineering
	Scientific Practical Techniques
	Fundamentals of Science
	Industrial Applications of Organic Chemistry
	Industrial Chemical Reactions

Essential resources

Learners need access to appropriate laboratory facilities and specialist resources to cover the contextualisation of the underlying concepts to their polymer specialism for example plastics, rubber or related areas. Site visits to relevant industrial facilities to see practical techniques in operation would be beneficial. Input from industry experts as guest speakers would enhance unit delivery.

Employer engagement and vocational contexts

British Plastics Federation

Cogent – Sector Skills Council

Network for Science, Technology, Engineering and Maths – Network Ambassadors Scheme

The Polymer Society

The Rubber in Engineering Group

Indicative reading for learners

Journals

British Rubber and Plastics

Materials Foresite

Materials World

Plastics, Rubber and Composites

Websites

www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/polymers.htm	Chemistry
www.bpf..co.uk	British Plastics Federation
www.cia.org.uk	Chemical Industries Association
www.cogent-ssc.com	Sector Skills Council
www.en.wikipedia.org/wiki/Natural_rubber	Natural Rubber
www.en.wikipedia.org/wiki/Synthetic_rubber	Synthetic Rubber
www.iom3.org	The Institute of Materials, Minerals and Mining (The Rubber in Engineering Group)
www.rsc.org.uk	The Royal Society of Chemistry
www.stemnet.org.uk	Network for Science, Technology, Engineering and Maths – Network Ambassadors Scheme

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are …
Independent enquirers	obtaining data and using results to predict properties
Team Workers	carrying out investigations
Reflective learners	communicating to different audiences
Self-managers	planning and completing experiments
Creative Thinkers	exploring mix designs.