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Level 4 Award in Waste Treatment Technologies

The Chartered Institution of Wastes Management

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Waste Implementation Programme
New Technologies

Contents

This document presents the structure of the Level 4 Award in Waste Treatment Technologies.

Qualification number: 500/1692/1

The first section introduces the five units:

1. Historical, Social and Legal context for Sustainable Waste Management
2. Physical Waste Management Technologies
3. Biological Waste Treatment Technologies
4. Advanced Thermal Waste Treatment Technologies
5. Integrated Treatment Technologies for Waste Management

The second section provides further detail, outlining the content of each of the lectures within the units.

Unit 1

Historical, Social and Legal context for Sustainable Waste Management

No. of taught hours: 7 (guideline)
No. of student-centred learning hours: 35 (guideline)
Unit status: Mandatory

Unit Overview:

This Unit has been designed as a mandatory unit on the subject of legislation and other drivers, decision making and licensing and permitting arrangements for the Level 4 Award in Waste Treatment Technologies. The purpose of this unit is to provide all students with the waste management background knowledge and context, decision making tools and legal requirements involved in the development and operation of an advanced waste management facility that they will require in order to successfully complete the subsequent technology based units. The unit will provide students with information about the many non-technical aspects that must be considered when planning new waste management facilities. Licensing and permitting requirements are outlined before the environmental monitoring and reporting requirements for the operation of advanced waste management facilities are discussed.

Before learning about the actual technologies themselves, it is important that students understand the legislation and other drivers that are responsible for the development and introduction of these new technologies. Lecture 1 therefore sets the scene by giving an historical perspective to waste management in the UK and the background for the 'step change' in how we now manage our wastes. It outlines the main European legislation that is driving the introduction of new technologies and how the UK is implementing it. Other drivers, such as a general increase in environmental awareness, are also covered.

Achieving this change will require the collective actions of individuals and organisations to identify and then implement the correct waste management solutions for the particular circumstances. The whole decision-making process, running through to the selection of appropriate technologies and the planning process for individual facilities, is covered during Lecture 2. The many aspects involved must be considered, ranging from technical suitability through to economic and social considerations, including possible public opposition. The student is introduced to the necessary decision-aiding tools that can help make comparisons between the technologies, relevant to the context in which any particular waste stream needs to be managed. The third lecture provides an overview of the UK planning and licensing/permitting systems and introduces the environmental reporting requirements for the operation of waste management facilities.

The learning materials have been designed taking into account that some students will have no prior knowledge of legal requirements involved with new waste management treatment technologies, whilst ensuring that the learning objectives conform to the level required at Level 4.

Lecture Structure:

	Lecture Title	Tuition	Private Study
U1_L1	Legislation and other drivers	2.5 hrs	12.5 hrs
U1_L2	Decision Making	2.5–3 hrs	12.5–15 hrs
U1_L3	Licensing and Permitting	1–1.5 hrs	5–7.5 hrs

On successful completion of the unit, students will be able to:

Learning Outcomes	**Legislation and Other Drivers** • Outline the history of waste management in the UK and why particular disposal techniques were used • Detail European and UK legislation that has led to the need to reduce the landfilling of biodegradable waste and to treat waste prior to landfilling • Discuss typical recycling/composting targets • Identify other drivers causing a shift away from landfill • Explain why biodegradable waste needs to be treated or disposed in ways other than by landfilling **Decision Making** • Evaluate scientific and trade literature relating to the different technologies • Identify potential advantages and disadvantages of particular technologies • Communicate findings and conclusions of technology assessments/comparisons to expert and lay audiences using written/verbal presentations • Make technical and financial appraisals of proposed new projects and processes • Prepare cases for the adoption of a particular technology or combination of technologies **Licensing and Permitting** • Outline the planning and permitting systems as applied to advanced waste management facilities • Identify potential barriers to the implementation of the particular technologies at particular locations • Determine likely monitoring and reporting requirements for the operation of advanced waste management facilities
Teaching Strategies	• Lecture • Class debate/group discussion • Group exercises • List of references to external sources
Assessment Strategies	• Group work project • Assessed class debate • Short answers/multiple choice on headlines for each section

Unit 2
Physical Waste Management Technologies

No. of taught hours: At least 6–7 (guideline)
No. of student-centred learning hours: 30–35 (guideline)
Unit status: Mandatory

Unit Overview:

This Unit has been designed as a stand-alone optional unit on the subject of existing and new physical processes for the Level 4 Award in Waste Treatment Technologies. The purpose of this unit is to provide all students with essential knowledge of physical waste management technologies and to introduce the terms associated with these.

Unit 2 covers physical resizing and separation operation technologies in some detail. Original application(s) and drivers as well as the technology of the different operations are also covered. The science of autoclaving and plant examples are reviewed, and a lecture on further emerging physical processes is provided, though outside the core body of work for the unit.

Lecture Structure:

	Lecture Title	Tuition	Private Study
U2_L1	Introduction; Resizing Technologies	2 hrs	10 hrs
U2_L2	Separation Technologies	3–4 hrs	15–20 hrs
U2_L3	Autoclaving Technologies	1 hrs	5 hrs
U2_L4	Annex – Other Technologies	(2–3 hrs)	(10–15 hrs)

Learning Outcomes
Teaching Strategies
Assessment Strategies

Learning outcomes, teaching strategies and assessment strategies are the same for the four technology units. These details are provided once, at the end of Unit 5 (page 7).

Unit 3
Biological Waste Treatment Technologies

No. of taught hours: At least 6–7 (guideline)
No. of student-centred learning hours: 30–35 (guideline)
Unit status: Mandatory

Unit Overview:

This Unit has been designed as a stand-alone optional unit on the subject of existing and new biological processes for the Level 4 Award in Waste Treatment Technologies. The purpose of this unit is to provide all students with essential knowledge of biological and chemical processes and to introduce the terms associated with these. The Unit then builds on this knowledge and introduces the different technologies in this sector. For example, the different configurations of the technology, the range of outputs, their possible markets, and process risks and benefits.

In accordance with one of the most pressing drivers – the diversion of biodegradable waste from landfill – the technology units primarily focus on the management of biodegradable wastes, particularly those associated with municipal solid wastes.

The learning materials have been designed taking into account that some post-graduate students will have no prior knowledge of the biological and chemical processes which occur when wastes are biologically treated, whilst ensuring that the learning objectives conform to higher order learning required at Level 4.

Lecture Structure:

	Lecture Title	Tuition	Private Study
U3_L1	Aerobic Processes	3–3.5 hrs	15–17.5 hrs
U3_L2	Anaerobic Processes	3–3.5 hrs	15–17.5 hrs

Learning Outcomes
Teaching Strategies
Assessment Strategies

Learning outcomes, teaching strategies and assessment strategies are the same for the four technology units. These details are provided once, at the end of Unit 5 (page 7).

Unit 4
Advanced Thermal Waste Treatment Technologies

No. of taught hours: At least 6–7 (guideline)
No. of student-centred learning hours: 30–35 (guideline)
Unit status: Mandatory

Unit Overview:

This Unit has been designed as a stand-alone optional unit on the subject of existing and new thermal waste treatment processes for the Level 4 Award in Waste Treatment Technologies. The purpose of this unit is to provide all students with essential knowledge of thermal processes and to introduce the terms associated with these. The Unit introduces the technologies in this sector, such as mass burn incineration, gasification and pyrolysis. It goes on to cover the different configurations of the technologies, emissions, the range of outputs, their possible markets, and process risks and benefits.

The learning materials have been designed taking into account that some post-graduate students will have no prior knowledge of thermal waste treatment processes, whilst ensuring that the learning objectives conform to higher order learning required at Level 4.

Lecture Structure:

	Lecture Title	Tuition	Private Study
U4_L1	Combustion Processes	3 hrs	15 hrs
U4_L2	Gasification and Pyrolysis	3 hrs	15 hrs
U4_L3	Annex – Emerging Technologies	1 hrs	5 hrs

Learning Outcomes
Teaching Strategies
Assessment Strategies

Learning outcomes, teaching strategies and assessment strategies are the same for the four technology units. These details are provided once, at the end of Unit 5 (page 7).

Unit 5
Integrated Treatment Technologies for Waste Management

No. of taught hours: At least 6–7 (guideline)
No. of student-centred learning hours: 30–35 (guideline)
Unit status: Mandatory

Unit Overview:

This Unit has been designed as a stand-alone mandatory unit on the subject of licensing and permitting arrangements for the Level 4 Award in Waste Treatment Technologies. The purpose of this unit is to provide all students with information on the legal requirements involved in the development and operation of an advanced waste management facility. It provides an overview of the UK planning and licensing/permitting systems and introduces the environmental reporting requirements for the operation of waste management facilities.

The unit provides an overview of UK planning law and the processes involved in obtaining planning permission. Licensing and permitting requirements are outlined before the environmental monitoring and reporting requirements for the operation of advanced waste management facilities are discussed.

The learning materials have been designed taking into account that some students will have no prior knowledge of the legal requirements involved in advanced waste management facilities, whilst ensuring that the learning objectives conform to higher order learning required at Level 4.

Lecture Structure:

	Lecture Title	Tuition	Private Study
U5_L1	Introduction and Overview	1 hrs	5 hrs
U5_L2	Applications	3–4 hrs	15–20 hrs
U5_L3	Outputs	1 hrs	5 hrs
U5_L4	Risks	1 hrs	5 hrs

Learning Outcomes
Teaching Strategies
Assessment Strategies

Learning outcomes, teaching strategies and assessment strategies are the same for the four technology units. These details are provided once, at the end of Unit 5 (page 7).

Technology Units:

Unit 2 – Physical Processes

Unit 3 – Biological Processes

Unit 4 – Thermal Processes

Unit 5 – Integrated Systems

Students will have the skills to:

Learning Outcomes	• Describe the scientific and engineering principles of each technology • Critically appraise current waste treatment technologies and discuss the differences between processes • List the waste and wastes streams suitable for treatment through each technology • List the environmental benefits and emissions/products associated with the processes • Discuss the extent to which the technology can assist in meeting targets for the diversion of BMW from landfill and for meeting other targets • List the benefits and limitations of the technology
Teaching Strategies	• Lecture • Class debate and discussion • Group exercises • Video • List of references to external sources • Field visits (where possible)
Assessment Strategies	• Group work project • Assessed class debate • Assignment • Short answers/multiple choice on headlines for each section • Case study/site visit write-up (where possible) • Portfolio work

Unit 1
Lecture by Lecture Outlines

History, Social and Legal context for Sustainable Waste Management technologies: Lecture 1 – Legislation and Other Drivers

No. of PowerPoint Slides: 65
No. of taught hours: At least 2.5 (guideline)
No. of student-centred learning hours: 12.5 (guideline)

Unit Overview:

This first lecture provides an historical introduction to waste management (waste treatment and disposal) and the background for the 'step change' in how we now manage our wastes. It outlines the main European legislation that is driving the introduction of new technologies and how the UK is implementing it. Other drivers, such as a general increase in environmental awareness, are also covered.

Overall Aims:

On completion of this unit and the presentation of the accompanying materials, the student will have the knowledge and understanding of:

- The history of waste management
- European legislation that is affecting the uptake of waste management technologies
- The implementation of EU directives into the UK
- Other drivers for advanced waste management technologies
- The implications that these factors have on waste management in the UK

	Description 1	Description 2	Description 3
Lecture Outline	Historical perspective	Review of how the UK has managed waste previously	Burning of household wastes Historical reliance on landfill, increasing air emission controls Move to advanced technologies
	European legislation	Overview of the main legislation that has caused the need for development of advanced waste management technologies (including the overall aims and the specific requirements on member states)	Waste Framework and Daughter directives Introduction to Landfill Directive and key requirements such as: - Ban on co-disposal - Reduced landfill of biodegradable waste - Requirement for waste to be treated prior to landfilling EU Environmental Action Plan
	UK legislation	Overview of how the UK has implemented the various EU Directives (including specific targets and fiscal controls)	Introduction to: - Waste and Emissions Trading (WET) Act 2004 - Recycling Credits - Waste Strategy 2000
	Other drivers	Economic, social, political, environmental, technological	Triple bottom line, landfill tax Agenda 21, public pressure Green politics, corporate ethics Resource conservation concerns Increased number and improved technologies
	Implications for the UK	Exploration of the impacts Scale of the problem	Current recycling and waste management statistics, future waste compositional issues for diversion, landfill allowance trading Measuring waste and data reliability, change of growth rates over time
Student activities	• The accompanying PowerPoint slides provide six group discussions		

History, Social and Legal context for Sustainable Waste Management technologies: Lecture 2 – Decision Making

No. of PowerPoint slides: 72 optional extras
No. of taught hours: At least 2.5–3 (guideline)
No. of student-centred learning hours: 12 (guideline)

Lecture Overview:

This lecture considers the factors that affect the choice of a waste management facility. The various aspects of consideration are shown, ranging from technical suitability through to economic and social considerations, including possible public opposition. The different tools are then introduced that can be used to compare the different technologies, based on the context in which any particular waste stream needs to be managed.

Overall Aims:

On completion of this unit and the presentation of the accompanying materials, the student will have the knowledge and understanding of:

- The factors involved in choosing an appropriate advance waste management technology,
- The factors involved in the design and siting of an advanced waste management facility
- The planning process and role of the public and other stakeholders in the overall decision making process

	Description 1	Description 2	Description 3
Lecture Outline	Factors involved in choosing an appropriate advanced waste management technology	Including technical, economic, social and institutional factors	Technical advantages and benefits of each technology for particular waste streams/types of waste Economic factors – impact of Capex, income from products, uncertainties, local authority funding constraints and non-financial costs Social – public perception and public involvement in choice of technology (introduction to planning constraints)
	Factors involved in the design (including size) and siting of an advanced waste management facility	Including technical, financial, social and political factors	Technical and economic advantages and disadvantages of small scale and large scale facilities for particular technologies Economies of scale/need for sharing of facilities (political considerations) Social impacts – public perception and public involvement
	Introduction to decision-making tools	Including options appraisal and life cycle assessment	Introduction to different tools and methods – uses, advantages and limitations
Student activities	• The accompanying PowerPoint slides provide one group discussion, two group exercises and one homework piece		

NOS Mapping	There are no National Occupational Standards relevant to this Unit.

Unit 1
Lecture by Lecture Outlines

History, Social and Legal context for Sustainable Waste Management: Lecture 3 – Licensing and Permitting

No. of PowerPoint Slides: 30
No. of Taught Hours: 1–1.5 (guideline)
No.of Student-Centred Learning Hours: 5–7.5 (guideline)

Lecture Overview:

This unit introduces the legal requirements involved in the development and operation of an advanced waste management facility. It provides an overview of the UK planning and licensing/permitting systems and introduces the environmental reporting requirements for the operation of waste management facilities.

Overall Aims:

On completion of this unit and the presentation of the accompanying materials, the student will have the knowledge and understanding of:

- UK planning law
- licensing/permitting law and the requirements for advanced waste treatment facilities
- the types of environmental and reporting requirements required for advanced waste treatment facilities

	Description 1	Description 2	Description 3
Lecture Outline	Introduction to the planning and licensing/ permitting (PPC) requirements for advanced waste treatment facilities	Overview of UK planning law and processes involved in obtaining planning permission	Planning authorities, planning policies Waste legislation Overview of IPPC and the types of installations
		Overview of licensing/ permitting requirements	Stages of IPPC, waste management licensing regulations, license conditions, technology specific guidance documents
	Introduction to the environmental monitoring and reporting requirements associated with the operation of advanced waste treatment facilities	Typical parameters to be monitored	
		Typical record keeping and reporting requirements	
Student activities	• The accompanying PowerPoint slides provide three group discussions		

NOS Mapping	There are no National Occupational Standards relevant to this Unit.

Physical Waste treatment Technologies
Lecture 1 – Resizing Technologies

No. of PowerPoint Slides: 24
No. of Taught Hours: At least 2 (guideline)
No. of Student-Centred Learning Hours: 10 (guideline)

Lecture Overview:

This and the next lecture examine the design and operation of material recovery facilities (MRFs). This first lecture examines physical resizing operations, looking at what they can do and reasons why they are included in MRFs and other waste facilities.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The drivers behind resizing technologies
- The different resizing technologies

	Description 1	Description 2	Description 3
Lecture Outline	Physical resizing operations	Drivers	
		Technologies	Hammer mill Ball mill Shredder Rotating drum Wet rotating drum Bag splitter Pre-baling operations Baling Optical separation
Student activities	• None provided		

NOS Mapping	See next lecture

Physical Waste Treatment Technologies: Lecture 2 – Separation Technologies

No. of PowerPoint Slides: 62
No. of Taught Hours: At least 3–4 (guideline)
No. of Student-Centred Learning Hours: 15–20 (guideline)

Lecture Overview:

This and the previous lecture examine the design and operation of material recovery facilities (MRFs). This lecture focuses on various pieces of waste separation technology. Armed with knowledge of both resizing and separation technologies, the students are introduced to 'clean' and 'dirty' MRFs and their differences, in terms of feedstock, technology, waste reception and products. The final section of the lecture briefly covers what are suitable waste streams for MRFs, what products, emissions & residues arise, the environmental benefits of MRFs, and possible problems and issues associated with the technology.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The science and technology of hydrogen production, autoclaving
- The drivers behind the technologies
- The treatment or disposal of any by-products

	Description 1	Description 2	Description 3
Lecture Outline	Physical Separation Operations	Drivers	
		Technologies	Tipping Manual handling Trommels and screens Magnetic separation Eddy current separation Wet, air, or ballistic separation Disc Screen and Debris-Roll Separation Optical Separation
	MRF technologies	Type of MRF	'Clean' and 'dirty' MRFs
			Plant examples
			MRF layout Waste streams Process outputs and handling Contamination Risks and benefits
Student activities	• The accompanying PowerPoint slides provide one group exercise. • There are also two process videos that can be used to challenge the students' critical appraisal skills.		

National Occupational Standards relevant to this Unit include:

NOS Mapping	• Prepare raw materials and equipment for processing (reference ID: MPA9) • Promote recycling services (reference ID: not provided) • Control site operations for the treatment of non-hazardous wastes (reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (reference ID: not provided) • Control the reception of non-hazardous waste (reference ID: not provided) • Control the movement of recyclable materials (reference ID: not provided) • Assist in operating equipment for the processing of recyclable materials (reference ID: not provided) • Assist in the handover of recyclable materials (reference ID: not provided) • Assist in the safe operation of the work vehicle during recycling operations (reference ID: not provided) • Clean and maintain processing facilities and equipment (reference ID: not provided) • Contribute to the security of processing facilities (reference ID: not provided) • Assist in the sorting and preparation of recyclable materials for processing (reference ID: not provided) • Assist in the maintenance of plant and equipment for processing (reference ID: not provided) • Mechanically handle recyclable materials (reference ID: not provided) • Control the handover of recyclable materials (reference ID: not provided) • Control the reception of recyclable materials (reference ID: not provided) • Sort and prepare recyclable materials for processing (reference ID: not provided) • Carry out routine checks on vehicles and plant used for the processing of recyclable materials (reference ID: not provided) • Operate specialised plant and equipment for the processing of recyclable materials (reference ID: not provided) • Control vehicle movements on site (reference ID: not provided) • Facilitate the maintenance of plant and equipment for the processing of recyclable materials (reference ID: not provided) • Prepare and check plant and equipment for the processing of recyclable materials (reference ID: not provided) • Operate plant for the processing of recyclable materials (reference ID: not provided) • Monitor and maintain the security of facilities used for the processing or storage of recyclable materials v2 (reference ID: not provided)

Unit 2
Lecture by Lecture Outlines

Physical Waste Treatment Technologies: Lecture 3 –Autoclaving Technologies

No. of PowerPoint Slides: 26
No. of Taught Hours: At least 1 (guideline)
No. of Student-Centred Learning Hours: 5 (guideline)

Lecture Overview:

This lecture examines autoclaving. The lecture gives an overview of the science behind the technology, including the feedstock that can be used. The drivers behind the development of the technology are discussed and each technology is illustrated by example of operating or proposed plants. The treatment and disposal of byproducts is considered, and market opportunities, risks and benefits are discussed. The generic strengths and weaknesses as well as the environmental and health benefits are reviewed.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The science and technology of autoclaving
- The drivers behind the technology
- The treatment or disposal of any by-products
- Environmental and health issues related to autoclaving

	Description 1	Description 2	Description 3
Lecture Outline	Autoclaving	Drivers	BVPI LATS Recovery and renewables
		Science behind the technology	Waste reception and storage Waste feed Materials screening with recyclables recovery Residue to landfill
		Examples of plant	Alliance Technology Group, Inc. (ATG) Estech Europe Ltd Thermsave
		Suitable waste streams Process outputs and handling	
		Risks and benefits	
Student activities	• The accompanying PowerPoint slides provides one group discussion		

NOS Mapping	• Prepare raw materials and equipment for processing (MPA9) • Control site operations for the treatment of non-hazardous wastes (Reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (Reference ID: not provided) • Control the reception of non-hazardous waste (Reference ID: not provided)

Physical Waste Treatment Technologies
Lecture 4 – Annex – Other Technologies

No. of PowerPoint Slides: 74
No. of Taught Hours: 2–3 (guideline)
No. of Student-Centred Learning Hours: 10–15 (guideline)

Lecture Overview:

This lecture discusses other physical processes such as ionisation and ion exchange, ultrasound, cryogenics and WEEE separation. The science behind ionisation and ion exchange, ultrasound, cryogenics and WEEE separation is explored and the drivers behind them are examined. The treatment and disposal of by-products is considered.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The science and technology of the use of ionisation and ion exchange, ultrasound, cryogenics and WEEE separation
- The drivers behind the technology
- The legislation governing WEEE
- The treatment or disposal of any by-products

	Description 1	Description 2	Description 3
Lecture Outline	Advanced technologies	Ultrasound	Original technology applications Science behind the technology Drivers behind technology development Example plant
		Cryogenics	Original technology applications Science behind the technology
		Alkaline Hydrolysis	Original technology applications Science behind the technology Examples of plant By-products and their treatment/ disposal
		Ionisation and Ion Exchange	Original technology applications Science behind the technology Drivers behind technology development Examples of processes By-products and their treatment/disposal
		WEEE Separation	Original technology applications Science behind the technology Drivers behind technology development Examples of plant By-products and their treatment/disposal
Student activities	• The accompanying PowerPoint slides provides one group exercise		

NOS Mapping	• Prepare raw materials and equipment for processing (MPA9) • Control site operations for the treatment of non-hazardous wastes (Reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (Reference ID: not provided) • Control the reception of non-hazardous waste (Reference ID: not provided)

Unit 3
Lecture by Lecture Outlines

Biological Waste Treatment Technologies: Lecture 1 – Aerobic

No. of PowerPoint Slides: 109 + 2 optional extras
No. of taught hours: 3–3.5 (guideline)
No. of student-centred learning hours: 15–17.5 (guideline)

Lecture Overview:

This lecture introduces the technology of composting. The science and engineering aspects, together with common variants is provided. The range of waste for which it is suitable, the outputs and emissions from the process and the potential benefits and risks associated with the technology are then examined.

Overall Aims:

On completion of this unit and the presentation of the accompanying materials, the student will have the knowledge and understanding of:

- Composting
- The mass balance associated with composting of organic wastes
- The UK composting standard (BS PAS 100)

	Description 1	Description 2	Description 3
Lecture Outline	Composting	Introduction	Biological decomposition processes, plant and soil cycle
		Scientific/engineering principles involved with traditional windrowing and different variations of in-vessel composting	Historical context, main drivers, advantages, disadvantages, process description, different process types, composting methods
		Range of wastes/waste streams for which anaerobic digestion is suitable	Wastes suitable and impact of feedstock composition
		Outputs/products including the factors affecting the quantity/quality/value of the products generated Emissions/ residues	Products including their treatment Compost standard Markets for products Applications, processing costs vs retail sales
		Environmental benefits	Reduction of fertiliser use, odour reduction, methane potential etc
		Potential problems/issues associated with the technology	Health impacts, fire risk, noise, economic considerations Public perceptions Planning considerations
Student activities	• The accompanying PowerPoint slides do not have any specific discussions, but there are six process videos that can be used to challenge the students' critical appraisal skills.		

National Occupational Standards relevant to this Unit include:

NOS Mapping	• Prepare raw materials and equipment for processing (reference ID: MPA9) • Promote Recycling Services (reference ID: not provided) • Sort and prepare recyclable materials for processing (reference ID: not provided) • Control site operations for the composting of biodegradable wastes (Reference ID: not provided) • Control the reception of non-hazardous waste (Reference ID: not provided)

Biological Waste Treatment Technologies: Lecture 2 – Anaerobic

No. of PowerPoint Slides: 89 + 2 optional extras
No. of taught hours: 3–3.5 (guideline)
No. of student-centred learning hours: 15–17.5 (guideline)

Lecture Overview:

This lecture introduces the technology of anaerobic digestion. The science and engineering aspects, together with common variants is provided. The range of waste for which it is suitable, the outputs and emissions from the process and the potential benefits and risks associated with the technology are then examined.

Overall Aims:

On completion of this unit and the presentation of the accompanying materials, the student will have the knowledge and understanding of:

- Anaerobic processes
- The mass balance associated with anaerobic processing of organic wastes

	Description 1	Description 2	Description 3
Lecture Outline	Anaerobic digestion	Scientific/engineering principles involved	Historical context, main drivers, advantages, disadvantages, process description, different process types
		Range of wastes/waste streams for Wwhich anaerobic digestion is suitable	Wastes suitable and impact of feedstock composition
		Outputs/products including the factors affecting the quantity/quality/value of the products generated	Products including their treatment Markets for products Applications, processing costs vs retail sales
		Emissions/ residues	
		Environmental benefits	Reduction of fertiliser use, odour reduction, methane potential etc
		Potential problems/issues associated with the technology	Health impacts, nitrogen vulnerable zones, fire risk, noise Public perceptions Planning considerations
Student activities	• The accompanying PowerPoint slides provide one group discussion • There are also three process videos that can be used to challenge the students' critical appraisal skills.		

National Occupational Standards relevant to this Unit include:

NOS Mapping	• Prepare raw materials and equipment for processing (MPA9) • Control site operations for the treatment of non-hazardous wastes (Reference ID: not provided) • Control the reception of non-hazardous waste (Reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (Reference ID: not provided)

Unit 4
Lecture by Lecture Outlines

Advanced Thermal Waste Treatment Technologies: Lecture 1 – Combustion Processes

No. of PowerPoint Slides: 83
No. of taught hours: 3 (guideline)
No. of student-centred learning hours: 15 (guideline)

Lecture Overview:

The thermal processing technology of combustion is explored in this lecture. This lecture discusses the different technology options, applications and configurations.

Different configurations of mass burn, rotary kiln and fluidised bed incinerators are reviewed and illustrated with examples from the UK and around the world. The co-firing of wastes at power stations is discussed and compared to firing coal alone.

The lecture concludes with an overview of the different chamber configurations.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The science and technology behind different incineration processes
- Which waste streams are well suited to each technology

	Description 1	Description 2	Description 3
Lecture Outline	Technologies of incineration	Mass Burn Incineration	Moving/sloping grate, Boiler configuration – horizontal, combination and vertical Operational process Mass and Energy balance Case studies
		Rotary Kiln Incineration	Operational process
		Fluidised Bed Incineration	Advantages and disadvantages of fluid bed incinerators
		Suitable Waste Streams	Waste and waste streams suited
		Process outputs, emissions and residues	Ash Pollutant emissions Wastewater Heat and Electricity
		Benefits and problems	
Student activities	• The accompanying PowerPoint slides provide one group discussion.		

National Occupational Standards relevant to this Unit include:

NOS Mapping	• Prepare raw materials and equipment for processing (MPA9) • Control site operations for the treatment of non-hazardous wastes (Reference ID: not provided) • Control the reception of non-hazardous waste (Reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (Reference ID: not provided)

Advanced Thermal Waste Treatment Technologies: Lecture 2 – Gasification and Pyrolysis

No. of PowerPoint Slides: 68
No. of taught hours: 3 (guideline)
No. of student-centred learning hours: 15 (guideline)

Lecture Overview:

The lecture explores the science and technology of pyrolysis and gasification. The process requirements and the treatment or disposal of by-products is examined in detail. The lecture discusses the concept of advanced thermal treatment and illustrates the topic with case studies from Thermoselect, Novera Energy, SilvaGas Steam Gasification Process and Avonmouth Facility (Compact Power). The lecture concludes with an overview of the funding available for research in the area of advanced thermal treatment.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The science and technology of pyrolysis and gasification
- The treatment and disposal methods for by-products of gasification and pyrolysis

	Description 1	Description 2	Description 3
Lecture Outline	Science and technologies	Gasification	Temperatures Advantages and disadvantages Types of gasification Mass balance
		Pyrolysis	Temperatures Advantages and disadvantages Mass balance
		By-product treatment/disposal	Syngas Hydrocarbon liquids
		Biodiesel and methanol production	Original technology applications Science behind the technology Drivers behind technology development Examples of plant Site design and specifications By-products and their treatment/disposal Standards for Products and Residuals
		Applications	Thermoselect Avonmouth Facility (Compact Power) Sekundärrohstoff-Verwertungszentrum Schwarze Pumpe (SVZ)
Student activities	• The accompanying PowerPoint slides provide two group discussion exercises • There are also three process videos that can be used to challenge the students' critical appraisal skills		

National Occupational Standards relevant to this Unit include:

NOS Mapping	• Prepare raw materials and equipment for processing (MPA9) • Control site operations for the treatment of non-hazardous wastes (Reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (Reference ID: not provided) • Control the reception of non-hazardous waste (Reference ID: not provided)

Unit 4
Lecture by Lecture Outlines

Advanced Thermal Waste Treatment Technologies: Lecture 3 – Annex - Emerging Technologies

No. of PowerPoint Slides: 23
No. of taught hours: 1 (guideline)
No. of student-centred learning hours: 15 (guideline)

Lecture Overview:

This lecture introduces the technologies of plasma gasification and oxidation. The science and engineering aspects, together with common variants is provided. The range of waste for which it is suitable, the outputs and emissions from the process and the potential benefits and risks associated with the technology are then examined.

Overall Aims:

On completion of this unit and the presentation of the accompanying materials, the student will have the knowledge and understanding of:

- Plasma gasification and oxidation

	Description 1	Description 2	Description 3
Lecture Outline	Plasma Gasification	**For each technology the following topics will be discussed (where information is available):** Scientific/engineering principles involved Examples of plant Site design and specification By-products and their treatment/disposal Strengths of their treatment	
Student activities	• None		

NOS Mapping	• There are no National Occupational Standards relevant to this Unit

Integrated Treatment Technologies for Waste Management: Lecture 1 – Introduction and Overview

No. of PowerPoint Slides: 37
No. of taught hours: 1 (guideline)
No. of student-centred learning hours: 5 (guideline)

Lecture Overview:

This lecture introduces integrated waste management systems in general, and mechanical biological treatment (MBT) in particular. The first section introduces the students to MBT, with comments on the history and general design commonalities seen across applications. After this brief overview about the generalities of the process, the lecture provides a recap on the individual unit operations that may be used in integrated waste management systems – physical operations, biological operations, and thermal operations. If Units 2, 3 and 4 have recently been delivered, these sections can be passed over very quickly, as they simply summarise what has been taught previously.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The concept of integrated waste management systems
- How MBT is just one possible combination of the unit operations previously discussed

	Description 1	Description 2	Description 3
Lecture Outline	Introduction to integrated waste management systems	What are integrated waste management systems?	
		Introduction to MBT	Definitions Four Steps Purpose of MBT MBT or BMT Post MBT Process schematics
	Recap on technologies	Physical Processes	Resizing and Separation technologies Clean and Dirty MRFs
		Biological Processes	Aerobic processes Anaerobic processes
		Thermal Processes	
Student activities	• The accompanying PowerPoint slides provide one group discussion.		

NOS Mapping	• See lecture 4 (page 25)

Integrated Treatment Technologies for Waste Management: Lecture 2 – Applications and Configurations

No. of PowerPoint Slides: 67 + 3
No. of taught hours: 3–4 (guideline)
No. of student-centred learning hours: 15–20 (guideline)

Lecture Overview:

This lecture describes how the different building blocks of waste management systems can be put together to create integrated systems. The process, scale, development status and waste input type of each technology are discussed. The treatment and use of process by-products are also examined. Commercially available MBT systems are reviewed. MBT facilities in the UK, Europe and around the world are discussed, and the students are encouraged to design a plant themselves.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The variety of commercially available MBT systems

	Description 1	Description 2	Description 3
Lecture Outline	Commercially available MBT systems	Agrivert/Biodegma Herhof Horstmann Bedminster Greenfinch Biogas ArrowBio Shanks EcoDeco Valorga CiViC / Premier Waste Thermsave Orchid Environmental	Process description Site design Waste input By-products and their treatment/ disposal Scale Development status
Student activities	• The accompanying PowerPoint slides provide one group exercise and one individual piece of homework		

NOS Mapping	• See lecture 4 (page 25)

Integrated Treatment Technologies for Waste Management: Lecture 3 – Process Outputs, Markets and Residuals

No. of PowerPoint Slides: 39
No. of taught hours: 1 (guideline)
No. of student-centred learning hours: 5 (guideline)

Lecture Overview:

The mix and quality of the outputs from integrated processes – although mainly MBT – are discussed in this lecture. The use of MBT biomass, for example, is reliant on the standard of the product. The standards required for the biomass to be eligible for use as renewable fuel or compost is discussed in the context of Renewable Obligation Certificates (ROCs), composting standards, the Animal By-Product Regulations and the future Solid Recovered Fuel (SRF). The impact of the composition of the waste on the mix of products is also discussed.

The demand for MBT facilities is considered in the light of the Landfill Directive's targets for biodegradable municipal waste diversion. The measurement of the reduction in biodegradability of the waste is explained and the markets for RDF and compost are described.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- The mix of product outputs from MBT processes
- The markets for end products
- The standards imposed on biomass product for use as a fuel or compost
- The influence of the Landfill Directive on MBT processing parameters

	Description 1	Description 2	Description 3
Lecture Outline	Product Mixes	Outputs	Recyclables Metals Compost-like output Refuse derived fuel Leachate Biogas Ash residues Impact of waste composition/ contamination
	Standards	Biomass content of fuel Compost standards	Potential fuel – eligibility for ROCs CEN TC 343 BSI PAS 100 The Soil Association Standard for Organic Food and Farming Animal By-Product Regulations
	Market development and appraisal	Effects of the Landfill Directive	Pre-treatment Measuring biodegradability RDF
		Markets for end products	RDF, Compost
Student activities	• The accompanying PowerPoint slides provide one group exercise.		

For NOS Mapping – See lecture 4 (page 25).

Unit 5
Lecture by Lecture Outlines

Integrated Treatment Technologies for Waste Management: Lecture 4 – Process Risks and Benefits

No. of PowerPoint Slides: 36
No. of taught hours: 1 (guideline)
No. of student-centred learning hours: 5 (guideline)

Lecture Overview:

The financial considerations associated with MBT are discussed in this lecture focussing on the capital and operating costs and different revenue streams. The financial implications of different contractual arrangements also discussed. The potential advantages and disadvantages of investing in MBT as a method of treating waste are examined.

The planning of waste facilities can be a contentious issue and this lecture looks at the Planning issues, public opposition and licensing issues associated with them.

Environmental and health issues are discussed in relation to plant siting, traffic, air emissions, dust and odour, noise, water resources, visual impact, pests and vermin, fire and explosions, nitrate vulnerable zones and ammonia and NOx emissions.

Overall Aims:

On completion of this lecture and after studying the accompanying materials, the student will have knowledge and understanding of:

- Financial considerations including capital investment costs, operating costs and potential sources of income
- The importance of environmental, health and social issues in the planning process

	Description 1	Description 2	Description 3
Lecture Outline	Process risks and benefits	Economic, financial and investment appraisal	Financial costs – capital and operating Different contractual arrangements Revenue streams – sale of products, current/anticipated gate fees and impact of ROCs Appraisal of advantages and disadvantages of MBT
		Process evaluation	Planning considerations Public Perceptions Licensing requirements
		Environment and health	Plant siting Traffic Air emissions / health effects Dust / odour Noise Water resources Visual impact Pests and vermin Fire and explosions Nitrogen Vulnerable Zones (NVZs) Critical loads
Student activities	• None		

National Occupational Standards relevant to this Unit include:

NOS Mapping	• Monitor and maintain the security of facilities used for the processing of recyclable materials (reference ID: not provided) • Facilitate the maintenance of plant and equipment for the processing of recyclable materials (reference ID: not provided) • Operate plant for the processing of recyclable materials (reference ID: not provided) • Collect, sort and process recyclable materials (reference ID: EC17) • Prepare raw materials and equipment for processing (Reference ID: MPA9) • Control site operations for the composting of biodegradable wastes (reference ID: not provided) • Control site operations for the treatment of non-hazardous wastes (reference ID: not provided) • Control the movement, sorting and storage of non-hazardous waste (reference ID: not provided) • Control the reception of non-hazardous waste (reference ID: not provided) • Prepare raw materials and equipment for processing (reference ID: MPA9) • Promote recycling services (reference ID: not provided)) • Control the movement of recyclable materials (reference ID: not provided) • Assist in operating equipment for the processing of recyclable materials (reference ID: not provided) • Assist in the handover of recyclable materials (reference ID: not provided) • Assist in the safe operation of the work vehicle during recycling operations (reference ID: not provided) • Clean and maintain processing facilities and equipment (reference ID: not provided) • Contribute to the security of processing facilities (reference ID: not provided) • Assist in the sorting and preparation of recyclable materials for processing (reference ID: not provided) • Assist in the maintenance of plant and equipment for processing (reference ID: not provided) • Mechanically handle recyclable materials (reference ID: not provided) • Control the handover of recyclable materials (reference ID: not provided) • Control the reception of recyclable materials (reference ID: not provided) • Sort and prepare recyclable materials for processing (reference ID: not provided) • Carry out routine checks on vehicles and plant used for the processing of recyclable materials (reference ID: not provided) • Operate specialised plant and equipment for the processing of recyclable materials (reference ID: not provided) • Control vehicle movements on site (reference ID: not provided) • Facilitate the maintenance of plant and equipment for the processing of recyclable materials (reference ID: not provided) • Prepare and check plant and equipment for the processing of recyclable materials (reference ID: not provided) • Operate plant for the processing of recyclable materials (reference ID: not provided) • Monitor and maintain the security of facilities used for the processing or storage of recyclable materials v2 (reference ID: not provided)

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