

# **Promoting the Uptake of Advanced Waste Management Technologies in the UK.**

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## **Förderung der Akzeptanz fortschrittlicher Behandlungstechniken in Grossbritannien**

### **Abstract**

In the year 2000/01, England sent 79% of its MSW arisings to landfill. That figure had fallen to 62% by 2005/06, but the UK still faces a huge challenge if it is to meet its Landfill Directive diversion targets. This paper lists various workstreams developed by the Department of the Environment, Food and Rural Affairs (Defra) to address this challenge, before focussing on the Education and Training Programme, which has been led by the author on behalf Defra and has been delivered three training courses.

The content and design of the three courses will be described in some detail, and example materials presented, focussing on MBT training. It is hoped that the materials will prove useful to universities and other training establishments outside the UK, and that the neutral nature of the materials, with no preference for any technology over another, will prove useful to delegates who need to make objective decisions about which technologies to pursue.

### **Keywords**

Training, Education, Masters, MBT, Defra, Lecture, Vocational

## **1 Background**

In November 2002, the UK Prime Minister's Strategy Unit published a report, "Waste Not, Want Not", recommending a package of measures to help the UK to meet the legally binding targets under Article Five of the EU Landfill Directive. The targets are tough, given the UK's traditional reliance on landfill as the primary means of waste disposal.

The Department of the Environment, Food and Rural Affairs (Defra), together with the Waste and Resources Action Programme (WRAP), responded by initiating the Waste Implementation Programme (WIP) in June 2003. This looked to tackle the issues on a number of fronts, via several workstreams:

1. Local Authority Support;
2. Local Authority Funding;
3. New Technologies;
4. Research;

5. Data;
6. Waste Minimisation;
7. Kerbside; and
8. Waste Awareness.

Since the launch of WIP, two further workstreams have been added, associated with Efficiencies and a Waste Infrastructure Delivery Programme. Discussion on the progress under each of these titles is beyond the scope of this paper, but the reader is referred to Defra's website for further information.

## **1.1 New Technologies Workstream**

The New Technologies focuses on the biodegradable element of municipal waste. It aims to overcome the barriers to the successful development and take-up of proven and near market waste technologies by providing a comprehensive package of support to local authorities and their stakeholders. It is made up of the following sub-workstreams:

- (a) Supporter Programme  
provides impartial information, advice and training to local authorities on a variety of aspects related to new and emerging waste management technologies
- (b) Waste Technologies Data Centre  
provides up to date information and advice on specific waste technologies covering regulation, authorisation, performance, costs and overall environmental value
- (c) Technology, Research and Innovation Fund (TRIF)  
provides funding for R&D projects into innovative new technologies
- (d) Demonstrator Programme  
providing £30 million of assistance to set up new waste treatment technology demonstration projects
- (e) Waste Technologies Advisory Committee  
set up to bring together representatives from the public, private, community, NGO and financial sectors, with the aim of helping to shape the focus and delivery of the two funding programmes
- (f) Education and Training Programme (see below)

## **1.2 The Education and Training Programme**

The Education and Training Programme was designed to promote a change of culture within the UK waste management industry, by providing an opportunity for those

working in the waste industry to gain formal qualifications in sustainable waste management and new waste management technologies.

Three courses have been developed, as follows:

- an M level (Masters) module in Advanced Waste Management Technologies
- a Higher Level Award (HLA) in Waste Management Technologies at Level 4
- a Level 3 Vocationally-Related Qualification (VRQ) in the Principles and Practices of Sustainable Wastes Management

## 2 Masters Module

Following the completion of draft materials last year, the Masters module was shared with educational establishments across the country, and several universities have already started incorporating the materials into their existing postgraduate courses. Lecturers were also asked for their comments, and feedback was received at several levels, the most fundamental being a suggested reordering of the materials, to make delivery more straightforward and easier to understand. In addition, there were many more minor adjustments suggested, to facilitate the use of the materials by lecturers, and to ensure consistency of quality in the lectures themselves. As far as possible, these modifications have now been incorporated into the course materials.

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| <p><b>1. Introduction</b><br/>Context and Background<br/>Policy Drivers<br/>Fundamental Process Economics<br/>Waste Arisings, Composition and Properties<br/>Spatial Variations, Collection Systems and Resource Potential</p> <p><b>2. Physical Processes</b><br/>Mass and Energy Balances<br/>Physical Resizing Operations<br/>Physical Separation Operations<br/>Autoclaving<br/>Other Physical Processes</p> <p><b>3. Biological Processes</b><br/>Introduction<br/>Aerobic Processes<br/>Anaerobic Processes<br/>Fermentation<br/>Process Outputs, Markets and Residues<br/>Process Risks and Benefits</p> | <p><b>4. Thermal Processes</b><br/>Introduction to Thermal Processes<br/>Combustion Processes<br/>Gasification and Pyrolysis<br/>Hydrogen Production<br/>Environmental and Health Impacts and Emissions Control<br/>Process Outputs, Markets and Residues; Process Risks and Benefits<br/>Advanced Technologies</p> <p><b>5. Integrated Systems</b><br/>Introduction<br/>Overview of Physical Processes<br/>Overview of Biological Processes<br/>Overview of Thermal Processes<br/>Applications and Configurations<br/>Process Outputs, Markets and Residues<br/>Process Risks and Benefits</p> <p><b>6. Decision Making</b><br/>Waste Strategies and Integrated Waste Management<br/>Planning for Waste Management Facilities<br/>Social Impacts and Communications<br/>Decision Tools (1): Procurement, Modelling, Fitness for Use and Life Cycle Assessment<br/>Decision Tools (2): Multi-Criteria Analysis, Risk Analysis, External Performance Criteria and Best Value Indicators</p> |
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**Figure 1** Lecture Structure for the Masters Course

The Masters module consists of six units. The first introductory unit provides students with the waste management background knowledge and context that they will require in order to complete the subsequent technology based units. The first three technology units look in turn at physical, biological and thermal waste treatment processes. Each unit looks at the science behind the technologies before examining the configurations being offered by providers, and reviewing the relative risks and benefits of each. The final technology unit, on integrated systems, looks at the various ways the technologies described previously can be put together. The most popular examples of integrated systems are the many mechanical-biological treatment systems now available, and these are examined in some detail. However, the lectures also look at the potential for incorporating thermal processes within these systems – particularly as dedicated treatment facilities for refuse-derived fuels. The sixth and final unit looks at decision-making. Topics in this section include waste strategies, planning, social implications and decision-making tools such as life cycle assessment and multi-criteria analysis.

As well as the lecture materials, the course pack will include class debates, coursework ideas, a list of potential guest lecturers and sets of questions and answers for examinations, all of which can be used and adapted as required by the universities.

### 3 HLA Course

The changes and improvements made to the Masters course have been fed through to the two vocational courses. Furthermore, pilots of each of the courses were run last summer, and much was learnt from the experience of delivering the courses that has been used to finalise the materials.

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| <p><b>1. Historical, Social and Legal Context for Sustainable Waste Management</b><br/>Legislation and Other Drivers<br/>Decision Making<br/>Licensing and Permitting</p>               | <p><b>4. Thermal Waste Management Technologies</b><br/>Combustion Processes<br/>Gasification and Pyrolysis<br/>Annex – Emerging Technologies</p> |
| <p><b>2. Physical Waste Management Technologies</b><br/>Introduction; Resizing Technologies<br/>Separation Technologies<br/>Autoclaving Technologies<br/>Annex – Other Technologies</p> | <p><b>5. Integrated Waste Management Systems</b><br/>Introduction and Overview<br/>Applications<br/>Outputs<br/>Risks</p>                        |
| <p><b>3. Biological Waste Management Technologies</b><br/>Aerobic Processes<br/>Anaerobic Processes</p>   |  |

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**Figure 2** Lecture Structure for the HLA Course

The Higher Level Award in Waste Management Technologies at Level 4 covers similar ground to the Masters module, but is aimed at providing professionals within the waste industry with a detailed understanding of the practical aspects of waste treatment processes. The coursework follows a similar structure to the Masters course, with an

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introductory unit followed by four technology sections (physical, biological and thermal treatment, and integrated systems).

The coursework may be delivered in a number of formats, but has been designed to fit into an intensive one-week course. The student must then complete a workplace-based assignment, which itself will culminate in a project report. The award will be based on successful completion of both parts of the course.

## 4 VRQ Course

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| 1. Principles of Sustainability                         | 5. Technical Aspects of Waste Management |
| 2. Waste Generation                                     | Waste Collection                         |
| 3. Policy and Legislation                               | Recycling                                |
| 4. Roles and Responsibilities of Different Stakeholders | Landfill and Incineration                |
| 5. Technical Aspects of Waste Management – see beside   | Composting                               |
| 6. Health and Safety                                    | Anaerobic Digestion                      |
|   | Mechanical-Biological Treatment          |
|   | Pyrolysis and Gasification               |
|   | Emerging Technologies                    |

**Figure 3** Lecture Structure for the VRQ Course

The level 3 VRQ has a slightly different focus, on Principles and Practices of Sustainable Wastes Management. It is aimed at process engineers and technicians, together with other professionals, who are looking to transfer into the waste industry. It was very well received by the pilot students, so changes have been kept to a minimum. Four introductory lectures are given, covering principles of sustainability, waste generation, policy and legislation, and roles and responsibilities within waste management. Nine lectures follow on the technical aspects of waste management, and these are followed by a final lecture on health and safety. Again, it is anticipated that the coursework materials would be delivered in a number of formats, but that a one-week intensive course is the most appropriate. The VRQ is also completed by a workplace assignment and report.

The CIWM will be distributing the course content to accredited universities and specifically licensed WAMITAB course centres.

## 5 Mechanical-Biological Treatment

This being an MBT conference, it is appropriate to dwell for a moment on how MBT is covered in the lectures. For both the masters module and the HLA, where more time is available to discuss the technologies, MBT is presented as the main form of integrated waste management system.

The lectures first cover physical unit operations in some detail, so that the students understand what each piece of machinery can achieve in isolation – how does a

shredder, a trommel, a ball mill, an overband magnet work? The second unit looks at various biological unit operations, and compares windrow operations with in-vessel composters, both aerobic and anaerobic. The third unit considers thermal processes, focussing on incineration first and then the more advanced gasification and pyrolysis techniques.

Equipped with all this information, the student is ready to assess integrated systems. The philosophy of this unit is that the operations previously described can be linked together to form integrated waste management plants, and that, when buying an MBT system, this is what is on offer. Each supplier has its preferred combinations, and many have unique unit operations, but most have (for example) shredders and trommels at certain points in their process. The key to choosing the correct integrated system – and the point is made that thermal processing may be added to the mechanical and biological – is to understand the particular feedstock that the plant will be accepting, and to stipulate clearly what output materials and qualities are required.

## 6 Course Materials

The exact details of the course materials varies between the courses, but Table 1 lists the body of information that has been gathered together to assist the lecturer in preparing for and delivering the materials.

**Table 1** Course Materials

| Materials                       | Description  |
|---------------------------------|--|
| Lectures                        | Lectures in Microsoft® PowerPoint®, frequently with support information for lecturer in the Slide Notes section  |
| Technology Videos               | Promotional video materials from 18 suppliers  |
| Web-Reference Library           | A library of (mostly) Adobe® PDF files, showing materials found on the internet  |
| Course Outlines                 | Documents detailing the structure of the courses, the intended learning outcomes, and suggested core teaching and assessment strategies to confirm that those outcomes have been achieved. The second section provides further detail, outlining the content of each of the lectures within the units.               |
| Lecture Support Notes           | Further information to support the lecture materials, to be used as background reading and as a basis for further student research   |
| Mass Balance Data               | Mass balance information on waste management technologies is still unreliable, because of the highly variable nature of municipal waste. Nevertheless, the mass balance information presented here should help the student gain a broad understanding of the relative performances of the different technology types |
| Tests, etc                      | Questions and model answers for the two vocational courses, and assignment and possible exam questions for the Masters module  |
| Miscellaneous Other Information | A possible guest lecturer list (for the UK), marking sheets for the vocational courses, and an extensive waste management glossary and acronym list  |

My presentation will include some of the materials, as a means to demonstrate what has been done.

## **7 Promoting the Uptake of Advanced Waste Management Technologies in the UK**

Since the initial announcement that these materials would soon be available, Defra, the Chartered Institute of Wastes Management (who will be the custodians of the materials) and ERM (consultants to Defra who prepared the materials) have received many enquiries about the courses from interested parties. The Business Services of CIWM intends to offer the two vocational courses in the near future, and other approved training centres will also be able to offer the courses.

At the same time, DVDs of the Masters materials have been supplied free of charge to all interested higher education establishments in the UK, with the expectation that the module will be integrated as an optional unit in many diverse courses, ranging from classical waste management degrees to more general environmental or engineering courses. The intention is to maximise the university audience that may come into contact with the materials.

It is hoped that increasing numbers of university graduates will be interested in waste management technologies (and perhaps will engage in research projects in the field) as a result of the masters module. Meanwhile, workers in the waste industry will have the opportunity to cement and build upon their knowledge, by gaining formal qualifications in waste management technologies. At the same time, workers in affiliated industries (such as water and brewing) will have the means to retrain if they wish to switch careers to the waste industry.

## **8 Summary**

This paper has explained how work on three waste technology training courses, for the Education and Training Programme, fits into the wider aims of Defra' Waste Implementation programme.

The combined result of the training courses should be more and better educated people in waste management, looking after the processes and making decisions about which technologies are most suited to their employers' requirements. Given the significant challenge that still faces the UK, to meet its Landfill Directive diversion targets, a larger and better educated workforce can only help to achieve the targets within the available time.

## 9 Literature and References

- |  |      |   |
|--|------|---|
| UK Prime Minister's Strategy Unit                          | 2002 | Waste Not, Want Not – A strategy for tackling the waste problem in England  |
| Department for Environment, Food and Rural Affairs (Defra) | 2003 | Government response to the Strategy Unit's report "Waste Not, Want Not"   |
| Defra's Waste Implementation Programme Website             |      | <a href="http://www.defra.gov.uk/environment/waste/wip/index.htm">http://www.defra.gov.uk/environment/waste/wip/index.htm</a> |
| The Environment Agency's Waste Technology Data Centre      |      | <a href="http://www.environment-agency.gov.uk/wtd">http://www.environment-agency.gov.uk/wtd</a>                               |

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