Making a positive difference for energy consumers

Renewables Obligation (RO) Guidance

Template methodology for measuring fossil derived contamination within waste wood

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Under the Renewables Obligation Order 2009 (RO 2009), as amended, fuelled electricity generating stations that burn waste wood as a fuel to produce electricity are required to demonstrate on a monthly basis, the biomass and fossil derived portions of the fuel as a percentage of total energy content. Ofgem requires this information for the purpose of issuing Renewables Obligation Certificates. Generators are required to propose fuel measurement and sampling procedures to obtain these values, which are subsequently agreed with Ofgem. This document provides a template methodology to demonstrate how the fossil derived energy content can be calculated. This document is not a definitive legal guide and fuel measurement and sampling methodologies submitted by operators will be considered by Ofgem on a case-by-case basis.

Contents

Introduction

The Renewables Obligation (RO) scheme was designed to encourage generation of electricity from eligible renewable sources in the UK. The RO scheme came into effect in 2002 in Great Britain, followed by Northern Ireland in 2005.

The scheme places an annual obligation on electricity suppliers to present to Ofgem a specified number of Renewables Obligation Certificates (ROCs) per megawatt hour (MWh) of electricity supplied to their customers during each obligation period (1 April – 31 March). Suppliers can meet their annual obligation by presenting ROCs, making a payment into a buy-out fund or a combination of the two.

ROCs are issued to operators of accredited renewable generating stations for the eligible renewable electricity they generate. Operators can trade ROCs with other parties or sell them directly to a supplier.

The administration cost of the scheme is recovered from the buy-out fund and the rest is distributed back to suppliers in proportion to the number of ROCs they presented to meet their individual obligation.

The Renewables Obligation scheme closed to all new generating capacity 1 April 2017.

For more information about the scheme, visit our website.

Relevant guidance

All documents are available at www.ofgem.gov.uk/

- Renewables Obligation: Sustainability Reporting
- Renewables Obligation: Biodiesel and fossil-derived bioliquids guidance
- Renewables Obligation: Guidance for Generators
- Renewables Obligation: Guidance for suppliers
- Renewables Obligation: Fuel Classification Flow Diagram
- Fuelled stations and fuel measurement and sampling (FMS)
- Renewable Electricity Register User Guide

Contacts

If you would like to contact us, visit the schemes contact page.

Please note that we can only provide guidance on the legislation that is currently in place. Any queries about changes to the ROO for England and Wales, and wider policy

should be directed to the Department for Energy Security and Net Zero (DESNZ). Contact details are at www.gov.uk/guidance/contact-desnz. For the ROS and NIRO Orders, contact details are available at www.scotland.gov.uk and www.economy-ni.gov.uk.

For queries related to the Quality Assurance for Combined Heat and Power (CHPQA) programme, please visit www.gov.uk/guidance/combined-heat-power-quality-assurance for contact details.

Relevant legislation

All legislation can be found at www.legislation.gov.uk:

- The Renewables Obligation Order 2015
- The Renewables Obligation (Scotland) Order 2009
- The Renewables Obligation Order (Northern Ireland) 2009
- Their respective amendment Orders

Executive Summary

Operators of fuelled generating stations that burn waste wood[1] are required to determine the biomass and fossil derived fractions by energy content of the feedstock burnt in a given month. The determination of which should be based on accurate and reliable information. Operators using this fuel source are required to propose a suitable methodology to determine the relevant fractions. Each methodology proposed will be considered by Ofgem on a case-by-case basis.

To assist operators that are considering how to measure the fossil derived contamination percentage of a waste wood fuel source, this guidance note provides an example that could be adapted for use. This example is based on figures and techniques proposed by industry and agreed by Ofgem. Ofgem encourages industry to lead the way in proposing FMS methodologies through sharing best practice and relevant data.

This guidance document outlines a methodology which can be adapted for use within a generating station where waste wood, containing fossil derived contamination, is used as a fuel source. The methodology includes calculations which can be undertaken to ascertain the overall percentage, by energy content, of fossil derived contamination within a representative fuel sample. This information is required by Ofgem for the purpose of issuing ROCs.

The methodology shows a series of calculations which can be undertaken to determine the contamination percentage, as a percentage of total energy content, for four fossil derived contaminants: plastics, resin binder, paint and varnish. The input data calculations use standard values alongside measured data obtained from lab analysis of a representative sample. The guidance note is accompanied by a waste wood contamination methodology spreadsheet which provides a worked example of the calculations.

Operators wishing to utilise this methodology will be required to demonstrate that it is fit for purpose given the specific waste wood fuel used on site. The list of four contaminants considered within the methodology is not exhaustive. Operators will still be required to account for the energy content of any other fossil derived contaminants present within

[1] Also referred to as recycled wood.

the fuel stream. Furthermore, justification will need to be provided that the 'standard values' included within the methodology e.g. for Gross Calorific Value (GCV) figures, apply to the contaminants found within their specific fuel stream.

The units primarily used within the methodology, for energy and weight respectively, are megajoules (MJ) and kilograms (kg). Operators can convert these to other units e.g. gigajoules (GJ) or tonnes (t), should this be desired. Providing the conversion is undertaken correctly and the units used in calculations are consistent this will not affect the results obtained from the methodology.

This document is not a definitive legal or technical guide, and each FMS proposal submitted will be reviewed by Ofgem on a case-by-case basis, taking account of the provisions of the orders, specific fuels, fossil derived contaminants and generation technology stated within the application. Before Ofgem can approve FMS procedures it must be satisfied that they will deliver accurate and reliable results.

The determination of fossil derived contamination is only one factor within a generating station’s wider FMS procedures. Operators choosing to adopt this methodology will still be required to complete a full FMS questionnaire document as part of the accreditation process and have this approved by Ofgem.

1. Methodology

Contaminants

1.1. The first step is for the operator to identify all the potential fossil derived contaminants within the waste wood fuel supply. The contaminants covered in this example methodology are:

- Plastics
- Resin binder
- Paint
- Varnish

1.2. The approach within the methodology for paint and varnish is the same and as such they are grouped. This list is not exhaustive and other contaminants may be present in waste wood feedstocks. Therefore, each operator will need to identify the full range of fossil derived based contamination present within its fuel supply and then account for its contribution to energy content.

Producing a Sample

1.3. The operator is required to produce a representative sample of the fuel used within the month for analysis, based on a suitable number of increments[2] taken throughout the month. The approach used to produce a sample will compose part of the generating station's FMS procedures, as agreed by Ofgem. The sample is then tested to ascertain its energy content on a GCV basis e.g. in gigajoules per tonne (GJ/t), megajoules per kilogram (MJ/kg) or kilojoules per gram (KJ/g).

1.4. Several sampling standards are available from the European Committee for Standardisation (CEN) which outlines suitable procedures to ensure an accurate sampling regime and therefore calculation results. These include:

- CEN/TS 14778-1:2005: Solid biofuels - Sampling - Part 1: Methods for sampling.
- CEN/TS 14780:2005: Solid biofuels - Methods for sample preparation.

[2] The operator will be required to demonstrate the number of samples required to deliver accurate results.

- CEN/TS 14918:2005: Solid biofuels - Method for the determination of calorific value.

1.5. Best practice is for samples to be analysed in a laboratory accredited to ISO 17025:2005 by the United Kingdom Accreditation Service (UKAS).

Calculating the energy content of individual contaminants

1.6. An example methodology for calculating the energy content of the contaminants set out in paragraph 1.1 of this document is outlined below.

Plastics

1.7. For this methodology, the plastic contamination within the sample must firstly be manually separated and weighed. The weight of plastics in the sample, as determined by manual separation, is then multiplied by a GCV value to give the energy content of plastics within the sample. A 'standard value'[3] GCV of 45 MJ/Kg[4] is utilised in this methodology.

$$\mathbf{W\ p \times GCV\ p = EC\ p}$$

W p = Weight of plastics in sample (Kg)

GCV p = Standard GCV Plastics (45 MJ/Kg)

EC p = Energy content of plastics in sample (MJ)

Resin binder

1.8. To calculate the resin binder content within the waste wood sample, it must first be analysed for nitrogen content percentage (on an 'as received' basis[5]). This forms part of the required laboratory analysis of the representative sample submitted. This nitrogen content is then used alongside the nitrogen content of

[3] A standard value is a value used in a calculation that has not been directly measured but has been accepted based on evidence.

[4] A generator has proposed this standard value to Ofgem and it was agreed. This is the highest figure from the following sources: Ullmann's Encyclopaedia of Industrial Chemistry, vol. A21, pg 45 (1981), Polymer Flammability (R.E. Lyon and M.L. Janssens, US Dept Transportation FAA), Heats of Combustion and
Potential Heat in Heat Release in Fires (V. Babrauskas and S.J. Grayson eds. Chapter 8 pp 207-223 Elsevier, London 1992), Heats of Combustion of High Temperature Polymers (R.N. Walters, S.M Hackett and R.E. Lyon US FAA).

[5] Test data evaluated relative to moisture in samples without conditioning.

virgin wood and the nitrogen content of resin within the methodology calculations.

1.9. A standard value of 0.36%[6] ('dry and ash free') is used for the nitrogen content of virgin wood. This should then be converted to an as received basis in order to be comparable to the waste wood sample. This involves the subtraction of the ash and moisture content by weight. Ash and moisture content should be determined by laboratory analysis. Within this methodology a standard value of 39%[7] is used for the nitrogen content of resin (again on an as received basis). Determining the resin content of the sample by energy content is now a three step processes, as outlined on the following page.

1.10. Step 1: Calculate the resin content of the sample by weight using the following calculation:

(NC s - NC vw) ÷ (NC r - NC vw)* = RC s (%)

*All Nitrogen Contents should be expressed on an as received basis.

NC s = Nitrogen content of sample (%)

NC vw = Nitrogen content of virgin wood (%)

NC r = Nitrogen content of resin (%)

NC vw = Nitrogen content of virgin wood (%)

RC s = Resin content of sample (%)

1.11. Step 2: To calculate the resin content of the sample by weight, the total weight of the waste wood sample must be multiplied by the % resin content of the sample (as calculated in Step 1).

W s × RC s = WRC s

[6] This value is based on initial testing of six samples of clean wood by the generator from their fuel supply [7] This is based on five samples carried out internally and confirmed by the calculation: urea-formaldehyde monomer has the molecular formula $C_2H_4N_2O$. This gives the formula mass of the monomer as 72.0536 g/mole, and the elemental composition as follows: C 33.3%, H 5.6%, N 38.9% and O 22.2%.

W s = Sample weight (Kg)

RC s = Resin content of sample (%)

WRC s = Resin content of sample by weight (Kg)

1.12. Step 3: To calculate the resin content of the sample by energy content the resin content by weight is multiplied by the GCV of resin. This methodology uses a standard value for resin GCV of 16 MJ/Kg[7].

WRC s × GCV r = EC r

WRC s = Resin content of sample by weight (Kg)

GCV r = Standard resin GCV (16 MJ/Kg)

EC r = Energy content of resin in sample (MJ)

Paint and varnish

1.13. Determining the paint and varnish content of the sample by energy content is a three step process, as explained below.

1.14. Step 1: The sample should be assessed in order to determine the area in cm of the sample that is covered in paint or varnish. A standard value of 0.0246 g/cm [8] can then be applied to determine the overall weight of paint or varnish in the sample. This is calculated by multiplying the surface coverage by this figure.

A pv × WA pv = W pv

A pv = Area of Waste wood sample covered in paint varnish (cm^2)

WA pv = Weight of paint varnish per cm^2 (0.0246g/cm^2)

W pv = Paint or varnish in sample by weight (g)

1.15. Step 2: Once the total weight of paint and varnish in the sample is determined in grams, it can then be converted to kilograms.

W pv (g) ÷ 1000 = W pv (Kg)

[7] This figure was based on the average GCV of analysed resins and agreed with Ofgem.
[8] Figure determined by an operator through laboratory based experimentation and agreed with Ofgem.

W pv = Paint or varnish in sample by weight

1.16. Step 3: The paint or varnish in waste wood sample by weight (Kg) is then multiplied by the standard value GCV of paint and varnish used within the methodology of 45 MJ/Kg[9] to give the energy content of the paint and varnish found within in the sample.

$$W\ pv \times GCV\ pv = EC\ pv$$

W pv = Paint or varnish in sample by weight (Kg)

GCV pv = Standard GCV of paint or varnish (45 MJ/Kg)

EC pv = Energy content of paint or varnish in sample (MJ)

1.17. NB: Whilst paint or varnishes are explicitly mentioned within this section, other related coating substances found within the waste wood sample could also be calculated using this methodology. Should the operator wish to apply the standard value energy content of 45 MJ/Kg for paint and varnish to other related coating substances they would need to demonstrate, to Ofgem's satisfaction, that it is applicable to the coatings in question.

Calculating overall fossil derived contamination within the sample

1.18. Calculating the overall fossil derived contamination percentage of the sample in terms of energy content, the figure required by Ofgem for undertaking ROC issue calculations, is now a two step process, as shown below.

1.19. Step 1: The energy content of each of the three contaminant groupings has been calculated. These can then be summed in order to give the total contamination content of the sample in terms of energy content (in MJ).

$$EC\ p + EC\ r + EC\ pv = EC\ c$$

EC p = Energy content of plastics in sample (MJ)

EC r = Energy content of resin in sample (MJ)

EC pv = Energy content of paint or varnish in sample (MJ)

EC c = Total energy content of contamination in sample (MJ)

[9] This corresponds to the GCV of polyethylene.

1.20. Step 2: To then calculate this as a percentage of the total energy content of the sample as a whole, the total energy content of the sample (in MJ) is needed. This will have been supplied though laboratory analysis as mentioned previously. Through dividing the total energy content of contaminants in the sample by the total energy content of the sample, and multiplying by 100, the overall fossil derived contamination by energy content is given as a percentage.

(EC c ÷ EC t) × 100 = EC cs

EC c = Total energy content of contamination in sample (MJ)

EC t = Total energy content of sample (MJ)

EC cs = Energy content of contamination within the sample (%)

1.21. This percentage figure (EC cs), for the representative sample is then reported to Ofgem on a monthly basis via the Renewable Electricity Register. This figure is subsequently applied to waste wood fuel use within that month and used in the calculation of ROCs to be issued.

Waste wood contamination methodology spreadsheet

1.22. To accompany these calculations Ofgem has published a waste wood contamination methodology spreadsheet, 'Renewables Obligation: template methodology for measuring fossil derived contamination within waste wood. Spreadsheet example'. This shows a worked example of how the methodology can be used. The spreadsheet includes all the standard values and formulas for the calculations outlined within this guidance note.

1.23. NB: This spreadsheet will need to be adapted to the specific fuels used within each generating station.

Appendix 1 – Glossary

C

CEN	European Committee for Standardisation

F

FMS	Fuel Measurement & Sampling

G

GJ	Gigajoule
GCV	Gross Calorific Value

K

kg	Kilogram
KJ	Kilojoule

M

MJ	Megajoule

R

ROC	Renewables Obligation Certificate

T

t	Tonne

U

UKAS	United Kingdom Accreditation Service