

How to demonstrate 'End of Waste' for syngas

Introduction

There is growing interest in the use of gasification and pyrolysis to recover material products from wastes such as plastics and tyres.

SEPA's Regulatory Position Statement on 'Permitting Pyrolysis and Gasification of Waste Activities' states that where the requirements of Article 42(1) of Directive 2010/75/EU on Industrial Emissions ('IED') are met, the activity will generally be permitted as a combustion activity under Section 1.2A(c) of Schedule 1 to the Pollution Prevention and Control (Scotland) Regulations 2012 ('the PPC Regulations') rather than as a waste incineration activity.

Article 42(1) states that the Chapter IV waste incineration requirements "shall not apply to gasification or pyrolysis plants, if the gases resulting from the thermal treatment of waste are purified to such an extent that they are no longer a waste prior to their incineration and they can cause emissions no higher than those resulting from the burning of natural gas." This guidance describes the evidence required to show that syngas produced from pyrolysis and gasification of waste meets the conditions laid out in Article 42(1).

End-of-Waste Test

Section 75 of the Environmental Protection Act 1990 (as amended) sets out the criteria which syngas must fulfil in order to cease to be waste.

"Waste which has undergone a recycling or other recovery operation is considered to have ceased to be waste if it complies with the following conditions:

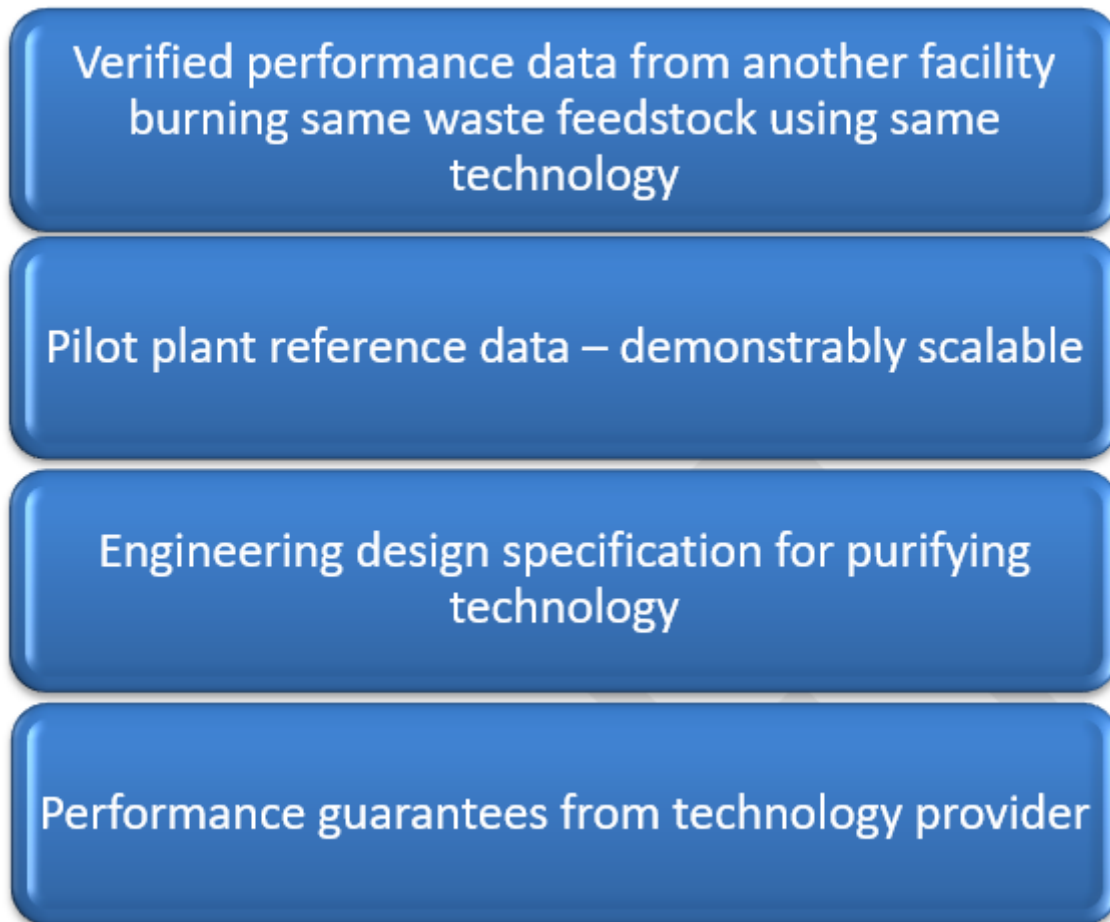
- a) the substance or object is to be used for specific purposes;
- b) a market or demand exists for such a substance or object;
- c) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and
- d) the use of the substance or object will not lead to overall adverse environmental or human health impacts."

Evidence Requirements

The more supporting evidence provided, the more likely the applicant will be to receive a permit for a combustion activity. Where an application is made for a combustion activity with no reference data, no pilot plant data, and no engineering design then SEPA will default to determining the application as an incineration application.

Applicants must demonstrate that the syngas specification will be met on an ongoing basis through a combination of the evidence set out in figure 1.

Figure 1: Evidence required to demonstrate syngas quality and technology selection



Syngas quality specification

The use of syngas must not lead to overall adverse environmental or human health impacts. Applicants must demonstrate through compositional data and technology choice that the syngas will always be able to meet the required specification.

The composition of raw syngas is influenced by the origin, nature and composition of the waste feedstock, moisture content, process temperatures, pressure and residence times and any gasification agent used in the process

The Environment Agency has produced a syngas specification (Appendix 2) based on the maximum results obtained from testing natural gas from one location in England. It also includes substances normally associated with the gasification and pyrolysis of waste.

The levels of contaminants could be different in other samples of natural gas and the specification may change in response to new evidence, provided those results can be shown to be representative of UK pipeline gas. SEPA will keep the substances and limits specified in Appendix 2 under review.

Applicants demonstrating their syngas can meet the Article 42(1) tests through comparison to the Appendix 2 specification (or their own comparator data) will normally obtain SEPA's opinion on new development proposals through their application for a Permit. This assessment will determine whether SEPA determines the Permit as a combustion activity or an incineration activity.

Process Evidence

Syngas must be capable of being burned in a plant that could equally burn natural gas. The combustion plant can undergo normal adjustments to account for difference in the fuel properties such as air/fuel ratio or engine ignition timing. However, there should be no special measures applied such as additional combustion stages, increased residence time or additional exhaust gas abatement.

Applicants must also demonstrate that syngas clean up techniques will be sufficient for the plant to meet the natural gas specification on an ongoing basis. Evidence should include the fate of substances produced through the thermal treatment process, referencing process temperatures, pressures and residence times. Applications should be supported by design specifications and/or performance guarantees from the technology provider, as well as any verified performance data from comparable plants. Common syngas clean-up techniques are outlined in Chapters 2 and 3 of the Ricardo technical document 'Establishing a methodology that supports the assessment of the impact of ATT processes' commissioned by the Environment Agency. Applicants should refer to comparable processes, facilities or methods of operation which have been tried with success at a commercial scale to justify the chosen techniques in relation to achieving Article 42(1) quality syngas.

Data from pilot plant and/or other commercially operational plant used to support the application must be using the same feedstock, thermal treatment and gas clean up techniques, and pilot plants must be demonstrably scalable. If verified performance data from another facility or pilot plant reference data is unavailable, in the BAT assessment the application should address;

- the sizing of scrubbers/vessels/other abatement plant is appropriate to achieve cleaned syngas specification;
- how controls on waste feedstock (on or off-site) will limit contamination in the feedstock that may impact syngas or char/ash quality and/or impact material handling systems (i.e. blockages);
- the fate of contaminants likely to arise from the thermal treatment of waste in relation to processing temperature, pressure and residence time, waste feedstock composition, moisture content and choice of gasification agent and whether substances arising from thermal treatment and gas clean-up will be present in wastewaters or ash/char;
- whether thermal treatment techniques support recovery of the char (e.g., as a vitrified ash);
- whether further treatment of thermal treatment residual outputs (e.g. char) are recovery processes and residues are not simply burned for disposal.

Processing of products such as Syngas, Synoil and Char

Waste thermal treatment plants designed to principally produce synthetic oils or char (and whose syngas meets the Article 42(1) requirements) can be considered to be in the scope of Section 1.2A(c) where the oil or chars are not burned, or where they meet a bespoke End-of-Waste opinion for each output prior to any combustion (on or off-site).

Commissioning and Ongoing Performance

Syngas composition must be demonstrated during the commissioning phase of the plant. Demonstration on an ongoing basis that the syngas meets Article 42(1) will normally be required on a sliding scale, with frequency of sampling and analysis of syngas decreasing as consistent composition is demonstrated, but for the potential for the frequency to once again be increased should any failures occur. Other indirect measurements will also be required to be monitored to ensure syngas composition remains within agreed spec.

If a permit is granted for a combustion activity, it is likely SEPA will include an interlock condition such that if the syn-gas goes out of spec before combustion, waste feed will automatically be stopped.

Definitions

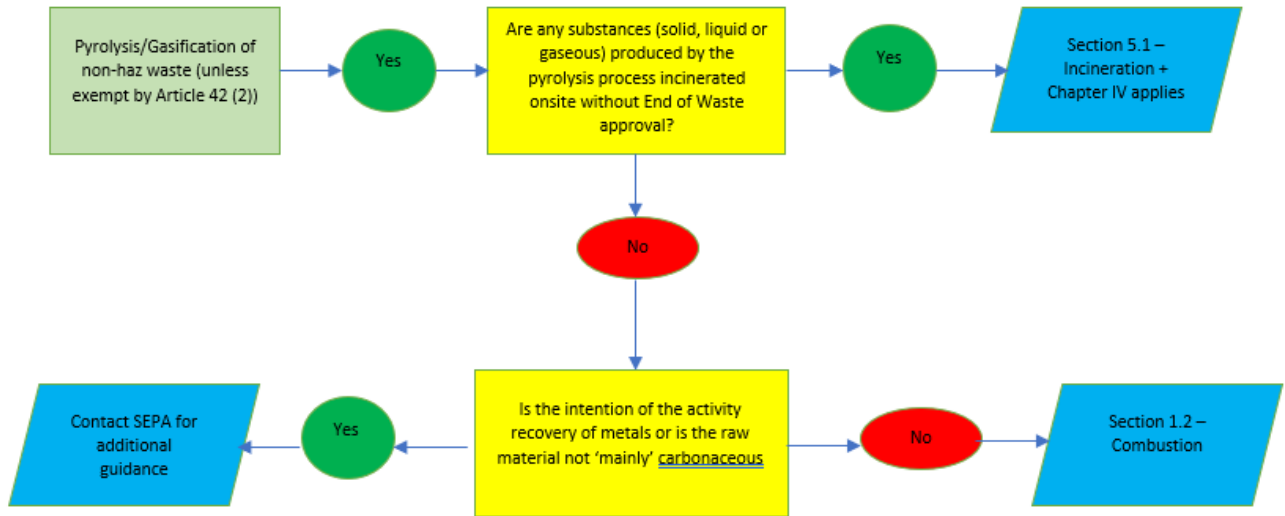
Incineration – the combustion of waste under conditions which ensure the destruction and oxidation of molecules, to the extent required in a waste incineration or waste co-incineration plant. This includes thermal treatment plant where resultant syngas is burnt and doesn't meet Article 42(1) requirements

Output – constituent outputs from the alternative thermal treatment of waste e.g. synthetic gas, wax, synthetic oil (synoil) and char, all of which may or may not be waste.

Syngas – gases resulting from the thermal treatment of carbonaceous material. The term is used here to cover pyrogas (from pyrolysis) and syngas (from gasification).

Thermal treatment – the application of heat to result in irreversible molecular change.

Appendix 1 – Flowchart



Appendix 2

Article 42 syngas specification

Parameter	Source	Current limit (mg/m ³) *	Basis of limit
Total Sulphur	Data from National Grid PLC continuous monitors over two day period (119 samples)	3.85	Odorised Concentration from JEP Report ¹
	Analysis of 9 natural gas samples		
Hydrogen sulphide	Data from National Grid PLC continuous monitors over two day period (119 samples)	0.4	Top of range from natural gas analysis
Total halogenated hydrocarbons	Analysis of 9 natural gas samples	0.07	Top of range from natural gas analysis
Heavy metals Hg, Cd, Tl, Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	Analysis of 9 natural gas samples	0.16	Top of range from natural gas analysis, excluding outlier
Total aromatic hydrocarbons expressed as Xylene	Analysis of 9 natural gas samples	2.6	Top of range from natural gas analysis
HF		5	Not likely to be present in natural gas, but could be present in syngas depending on the type of waste that is treated. Limits from Biomethane Quality Protocol
HCl		1.5	
Calorific value	Analysis of 9 natural gas samples	Monitor	No limit but monitored so that syngas results can be adjusted to account for lower CV than natural gas

* These limits will apply unless the applicant can propose and justify an alternative limit e.g. further test results on natural gas composition

¹ JEP11SG01: EMISSION FACTORS FOR SULPHUR IN NATURAL GAS – February 2012