Newton Aycliffe Clinical Waste

Assessment on R1 based on Expected Performance

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Basis of Report

Executive Summary

The Newton Aycliffe facility is being developed to provide a thermal treatment solution to Clinical and other specialist material streams.

The facility has been designed to comply with the definition of a “recovery” facility that is compliant within the hierarchy of waste management set out previously within the Waste Framework Directive (Directive 20208/98/EC).

In order to achieve this, Fornax has identified consumers to be attached to a heat distribution network such that a large proportion of heat generated from the facility can be utilised to replace the use of other fossil fuels at those sites.

This report details the calculation used and demonstrates that the plant design allows for sufficient heat to be supplied to meet the R1 requirement.

It is important to note that the calculations within this report detail the performance of the plant and its heat distribution network at a level which just satisfies the requirements to achieve R1. When in operation, the heat distribution network is indented to supply an even greater proportion of heat to consumers, thereby achieving an even better environmental performance.

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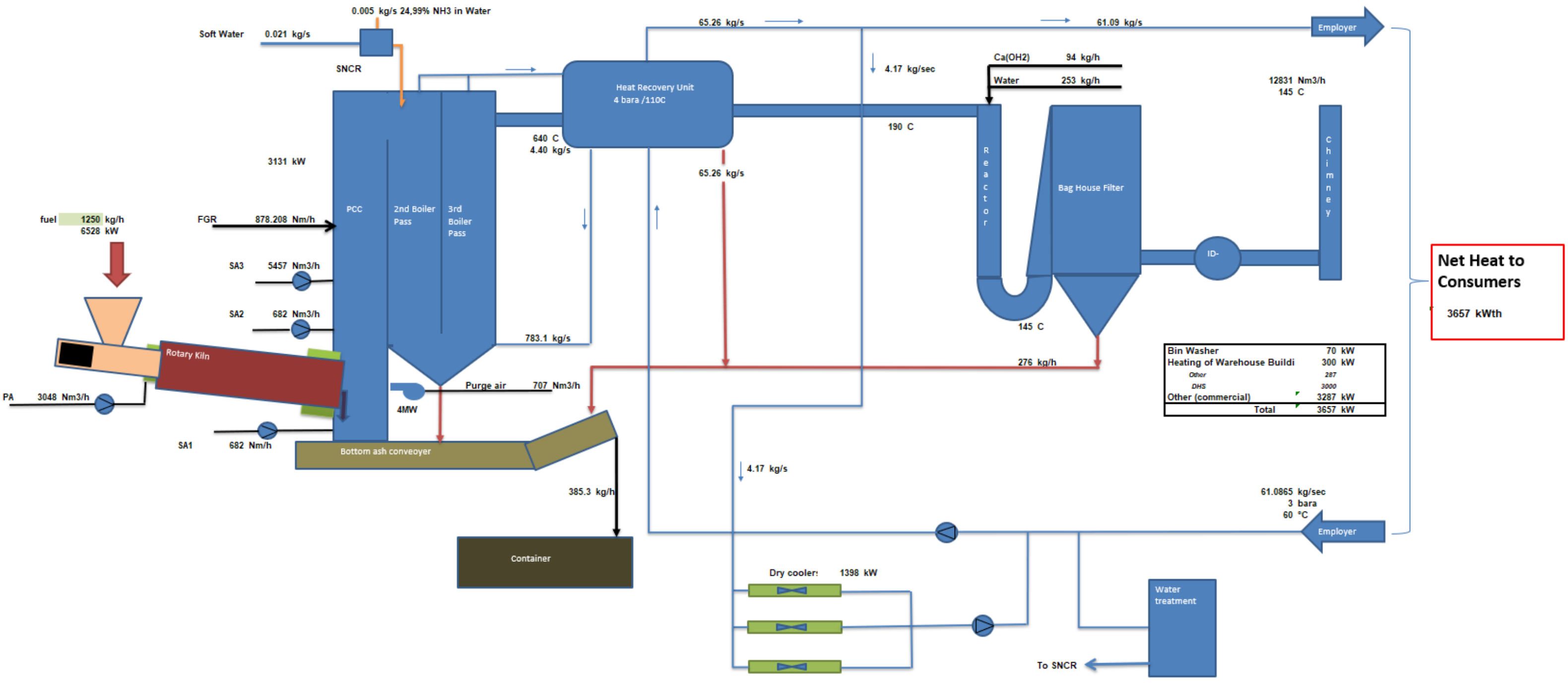
1.0 Introduction

This document provides an in-depth overview of the R1 process, including the Process Flow Diagram (PFD), the R1 Data Sheet, and a Sankey diagram. Each section contains detailed descriptions to facilitate a comprehensive calculation of R1 value and understanding of the process and its components. Additionally, the document discusses the significance and value of the R1 process in the context of energy recovery and efficiency.

2.0 R1 Process Flow Diagram (PFD)

The Process Flow Diagram (PFD) illustrates the flow of materials and energy within the R1 system. Key components include the Bin Washer, which consumes 70 kW of power to clean bins, and the Heating of Warehouse Building, which requires 300 kW to maintain optimal temperature conditions. The system also includes Dry Coolers that dissipate excess heat, and the SNCR System, which reduces NOx emissions by injecting ammonia or urea into the flue gas. The Heat Recovery Unit captures waste heat from the process, enhancing overall energy efficiency. The PFD details various flow rates, temperatures, and energy inputs and outputs at different stages, providing a comprehensive overview of the operational setup.

Figure 2-1 Process Flow Diagram



3.0 R1 Data Sheet

The R1 Data Sheet presents critical operational data for the R1 process. It specifies one boiler line operating for 8300 hours annually, with a waste feed rate of 1250 kg/hr, totalling 10,375 tonnes per year. The system uses 209 MWh of natural gas for start-up, with a total fuel energy input of 6580.195 kW. The total electrical consumption is 1,099.1 MWh per year, while electricity production stands at 33,388 MWh per year. This data highlights the system's capacity to handle significant waste volumes and its efficiency in converting energy inputs to outputs. The R1 value, calculated at 66.44%, indicates a high conversion rate of energy inputs to useful outputs, demonstrating the system's effectiveness in energy recovery.

Figure 3-1 Data Sheet

Raw Data

	Parameter	Unit	Value
1	**Boiler lines**		1
2	**Yearly operating hours**	hrs/yr	8300
3	**Waste Energy Input**		
3.1	Waste Feed	kg/hr	1,250
3.2	Waste NCV	kJ/kg	18800
3.2.1	NCV	MJ/kg	17.2
3.2.2	NCV	MJ/tonne	0.0172
4	**Start Up**		
4.1	Annual start-up	pcs	8
4.2	Full load period	hrs	4
5	**Fuel Energy Input**		
5.1	Fuel	kW	6528
5.2	Combustion air	kW	0
5.3	SNCR	kW	11
5.4	FGR	kW	41
5.5	Total Fuel Energy Input	kW	6580.195
6	**Electricity Consumption**		
6.1	CA-fan	kW	23
6.2	ID-fan	kW	24
6.3	Dry coolers	kW	0
6.4	Feed water pump	kW	35
6.5	Boiler circulation pump	kW	0
6.6	Aux consumption	kW	50
6.7	Total Electrical Consumption	kW	132
6.7.1	Total Electrical Consumption	MW	0.13
6.7.2	Total Electrical Consumption	MWh/yr	1,099.1
7	**Electricity production**		
7.1.1	Bin Washer	kW	70
7.1.2	Heating of warehouse building	kW	300
7.1.3	Other (commercial)	kW	3,287
7.1.4	Condenser	kW	n/a
7.1.5	Dry Coolers	kW	1398
7.1	Heat Reuse	kW	3,657
7.2.1	Turbine Output	kW	0
7.2	Electricity Reuse	kW	0
8	**Equivalence factor**		
8.1	Heat Equivalence factor	-	1.1
8.2	Electricity Equivalence factor	-	2.6

R1 Calculation - SLR

Ew - Energy input to the system from waste	**Amount**	**Units**
Waste Feed	1250	kg/hr
Waste Feed	1.250042553	tonne/hr
Waste Feed	10,375	tonne/yr
Ew	178	MJ/yr
Ew	178,456	GJ/yr
Ew	49,571	MWh

Ef - Energy imported for steam production	**Amount**	**Units**
Natural gas for start up	209	MWh

Ei - Energy imported	**Amount**	**Units**
Electrical consumption	1099	MWh

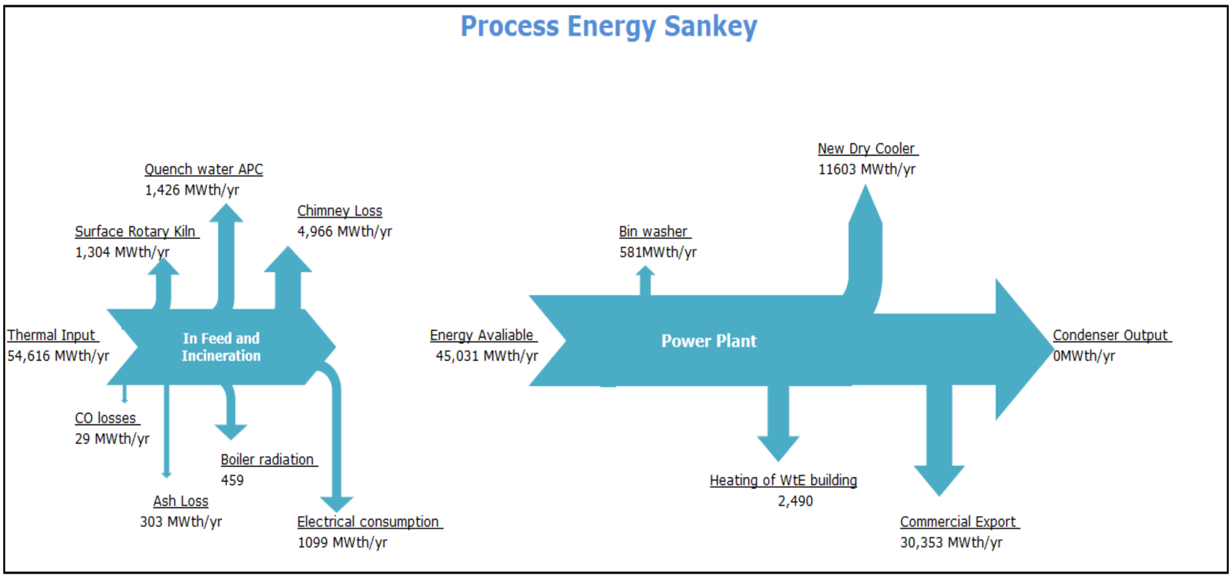
Ep - Electricity production	**Amount**	**Units**
Heat Reuse	3,657	kW
Heat Reuse (x1.1)	4,023	kW
Total Heat Reuse	33,388	MWh/yr
Electricity Reuse	0	kW
Electricity Reuse (x2.6)	0	kW
Total Electricity Reuse	0	MWh/yr
Ep - Energy production	33,388	MWh/yr

R1 (MWh)	**66.44%**	**%**

4.0 Sankey Diagram

The Sankey diagram visualizes the energy distribution within the R1 process, emphasizing the flow of energy inputs, outputs, and losses. Energy inputs primarily come from the waste feed and natural gas used for start-up. Energy outputs are distributed to various applications, including the heating of the warehouse, bin washing, and commercial export. The diagram also identifies energy losses occurring at different stages, such as through exhaust gases and cooling processes. This visualization is instrumental in identifying areas for potential improvement in energy efficiency, allowing for targeted optimizations in the R1 process.

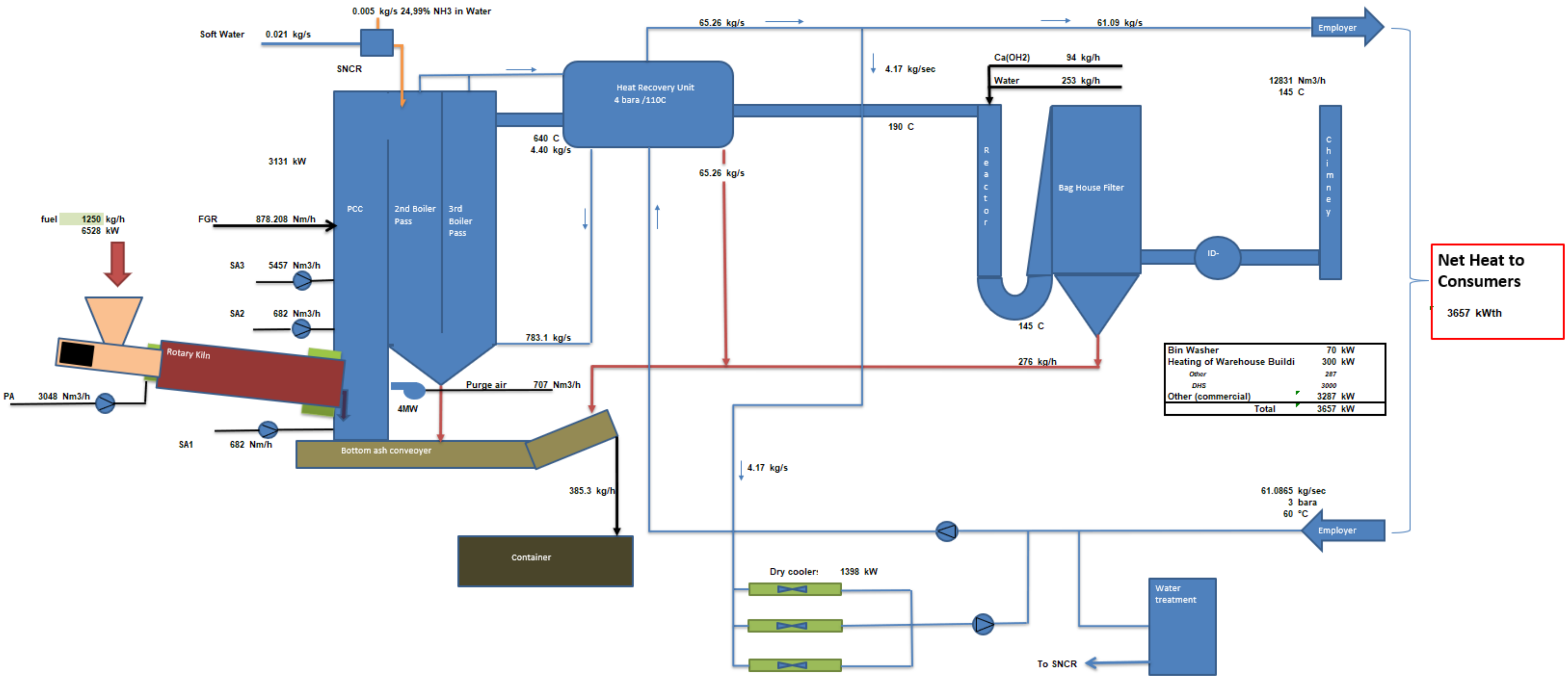
Figure 4-1 Process Energy Sankey Diagram



5.0 Conclusion

The R1 process demonstrates a calculated value of 66.44%, reflecting a high efficiency in energy recovery. This value aligns well with regulatory-defined standards for waste-to-energy systems, which require an R1 value of at least 60% to qualify as efficient energy recovery facilities. The high R1 value indicates that the system effectively converts a significant portion of the energy input from waste materials into useful outputs, such as heat. The efficient energy recovery capabilities of the R1 system position it as a viable solution for meeting both operational efficiency and regulatory requirements.

6.0 Appendix A – Enlarged Process Flow Diagram



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