Novidon Limited

In-process Controls

Application for Environmental Permit for Modified Starch Manufacturing Facility and Medium Combustion Plant

Coed Aben Road, Wrexham Industrial Estate, Wrexham, Clwyd, LL13 9UH

Report Ref: CE-WH-1801-RP01-IPC-V2-FINAL

Produced by Crestwood Environmental Ltd.

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Version & Status	Date Produced	Written / Updated by:	Checked & Authorised by:
Draft	20/01/2021	Mike Fisher Ph.D, GRSC, M.Phil, EurChem, C.Sci, C.Chem, MRSC, C.Biol, MRSB, MCIWEM, C.WEM Stephen Barnes BSc (Hons), MCIWM, CEnv	Andrew Abbott BSc (Hons), MSc
Final V1	06/01/2023	Louise Parsons BSc (Hons), MSc, MCIWEM	Andrew Abbott BSc (Hons), MSc
Final V2	29/02/2024	Rowena Maitland (Senior Consultant)	Kate Brady (Principal Consultant)

Crestwood Environmental Ltd.
Science, Technology and Prototyping Centre
University Of Wolverhampton Science Park,
Glaisher Drive, Wolverhampton,
West Midlands, WV10 9RU

Email: info@crestwoodenvironmental.co.uk
Web: www.crestwoodenvironmental.co.uk

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1 SITE DETAILS

1.1 BACKGROUND

1.1.1 This In-Process Controls report supports an Environmental Permit application for a modified starch manufacturing facility and a proposed combined heat and power (CHP) plant at Coed Aben Road, Wrexham Industrial Estate, Wrexham, Clwyd, LL13 9UH ***(the Site)***. The Site is operated by Novidon Limited ***(the Applicant and Operator)***.

1.1.2 The Site modifies starches to produce high quality wallpaper paste flake and drilling starches for the geological drilling industries. At present circa 10,000 tonnes of unrefined starch (dry solids) are refined per annum to produce circa 15,000 tonnes per annum of modified starches. The Operator proposes to increase annual production of modified starches to 30,000 tonnes by 2030.

1.1.3 In addition, it is proposed to install a Jenbacher combined heat and power (CHP) plant to generate electricity and heat for parasitic use at the Site. The CHP plant will comprise a Jenbacher J312GS gas engine, which has an electrical output of 524Kw/hr and a recoverable heat output of 659 Kw/hr. Its net rated thermal input is 1363Kw/hr, as a result of which it will be classed as a Medium Combustion Plant.

1.1.4 The CHP is not currently installed at the Site and it is a possible proposal in a few year's time. It has been considered within this permit application should the decision be made to commission in the future. In light of this, there are no environmental impacts from this activity at present.

1.1.5 The Site comprises a dedicated, enclosed building with a concrete floor and an external concreted yard area. The condition and integrity of both the building and internal concrete floor are good. The floor is fully sealed, with no internal drainage outlet, meaning that any inadvertent spillages or leakages within the building are fully contained. All manufacturing processes take place within the building and the proposed CHP plant will be located within a dedicated enclosure, within the building complex.

1.2 SITE ACTIVITIES

1.2.1 The Site falls under the requirements of the Environmental Permitting (England and Wales) Regulations 2016 and the Environmental Permitting (England and Wales) (Amendment) Regulations 2018, by virtue of:

- Schedule 1, Part 2, Chapter 4, Section 4.1, Part A (1):

  (a) (ii) organic compounds containing oxygen (e.g. alcohols, aldehydes, ketones, carboxylic acids, esters, ethers, peroxides, phenols, epoxy resins)

- Schedule 25A, Part 1, Paragraph 2(1):

  "new medium combustion plant" (means a medium combustion plant which is not an existing medium combustion plant).

- Schedule 25B, Part 1, Paragraph 2(1) (a) (i):

"generator, other than an excluded generator, with a rated thermal input—

(a) more than or equal to 1 megawatt and less than 50 megawatts".

1.2.2 Table 1 below details the Directly Associated Activities on Site.

Table 1: Directly Associated Activities

Directly Associated Activity	Description
Receipt and dispatch of materials	Receiving and checking raw material deliveries, storage in suitable locations, transfer to process area, dispatch of completed starch product.
Combustion of mains gas in dryer plant.	Combustion of natural gas in a 2000kW dryer to dry starch refined on site.
Combustion of mains gas in steam boilers	Combustion of natural gas in steam boilers to provide heat to dryers and reactor tanks.
Abatement of emissions to foul sewer	Operation of scrubber, using water as the scrubbing media.
Waste storage and handling	Collection of waste, storage of waste. Removal from site by approved contractors.

1.2.3 The external yard area comprises an engineered concrete surface. Surface water run-off from the yard falls to surface water drains which discharge to surface water sewer, which in turn falls to the Redwither Brook. There are two discharge points to the sewer on Site and both drainage runs are fitted with penstock valves close to and upstream of the discharge points (see Drawing DW02 'Drainage Layout'). The penstock valves are kept closed as a matter of routine and are only opened as required to allow off Site drainage of yard and building roof water runoff. Runoff water is only released if confirmed to be suitable (i.e. there have been no accidental spillages or leakages). Therefore, in the event of an accidental spillage on Site, the penstock valves would already be shut, thereby preventing any discharge to the sewer. It is important to note that all manufacturing processes take place inside the building and not on the external yard area. There is no drainage within the building (i.e. it is a fully contained system) and therefore no connection to the external yard drainage system.

1.2.4 There is a foul sewer drainage system on Site, which receives waste waters from the welfare facilities (e.g. toilets and wash basins) and surplus water from wash downs and scrubber liquours associated with the manufacturing process (see below). A Trade Effluent Discharge Consent, issued by Dwr Cymru Cyfyngedig (Welsh Water) is in force for the Site, see Appendix 1.

2 PROCESS DESCRIPTION

2.1 OVERVIEW

2.1.1 The Operator produces modified starch products, using both imported unrefined starches and refined starches.

Imported Unrefined Starch

2.1.2 Imported unrefined starches are purified on Site in several stages. The impure starch is hoisted into

a main mixing tank where it is blended with water to the required specific gravity (measured in Baumé). The blend is then sieved using a shaker sieve followed by a rotary sieve. This is followed by a rotary tank and a cyclone to remove sand waste. The sand is bagged prior to removal and recycling off-Site. The mixture is then transferred to another tank prior to the refining process. The blend is then transferred to the vacuum filters. The water from the filtration process is recovered for reuse. Starch recovered from the filtration process is dried prior to being bagged as a precursor for the modification processes (see below). A process overview is shown in Appendix 2.

2.1.3 A 2000 kW gas burner is used to dry the starch during the refining process. Emissions from the drying process comprise water vapour and these are vented to atmosphere via a 7.5m high stack.

Imported Refined Starch

2.1.4 Imported refined starch is brought into the facility in 1 tonne sacks and is stored on Site within the building prior to being used in the starch modification processes on Site.

Starch Modification Processes

2.1.5 Refined starch is modified in several stages:

I. Reaction with sodium hydroxide and cross-linking agents in two large reaction vessels.

II. SMCA is produced 'in-house' by the Operator by the controlled reaction of sodium hydroxide solution (32% rayon grade) with 80% monochloroacetic acid, which is an esterification agent to modify the starch. This reaction is exothermic and this part of the plant is controlled by temperature sensors which are alarmed over 65°C. At 78°C the water deluge system retards the reaction. This reaction has to be carried out at above 30°C. The reaction product is retained in the tanks and not released.

III. Transfer of the admixture to three horizontal mixing tanks where sodium monochloroacetate (SMCA) is added to produce a carboxylate derivative via carboxymethylisation. The resultant product is then dropped out of the reaction vessels where it is transferred to dryers (there are five dryers on Site for this purpose). The moisture content prior to drying is 32%. The dryers use heat derived from an existing steam boiler on Site (see Section 2.4).

IV. The scrubber water is 6 monthly refreshed. The used water is discharged to the foul sewer in accordance with a Trade Effluent Discharge Consent, issued by Dwr Cymru Cyfyngedig (Welsh Water).

V. This product then goes into the flakers to produce a fine flake which is then dosed with mergal (a biocide used to preserve product integrity prior to bagging and sale). The manufactured product is a high-quality wallpaper paste flake.

VI. Any low grade or rejected flakes for wallpaper paste production are instead bagged for use as a drilling starch for supply to the geological drilling industry.

VII. A scrubber is installed on Site which is designed to capture off gas from the SMCA storage tank, whilst it is filled. The scrubber media is water, which runs in constant recirculation to capture any volatile SMCA vapor if present. A 6m pipe vents emissions from the top of the scrubber and exits horizontally through the side of the building wall. Spent scrubber water is

discharged to foul sewer in accordance with the Trade Effluent Discharge Consent (see Appendix 1).

2.1.1 In addition, the Operator proposes to use propylene oxide in a separate starch modification process, see Section 2.3.

2.2 CARBOXYMETHYLISATION STARCH MODIFICATION

2.2.1 Refined starch is mixed with water and a cross linking agent in 2 x 12 m^3 mixing tanks. These tanks are open and the contents are mixed using stainless steel impellers. The resulting mixture is then transferred to three horizontal tanks where SMCA and 32% Caustic are added and heated. This is carboxymethlylisation and the reaction product is a carboxylated starch. The product is then transferred to the driers. The moisture content of the product is about 32%. The driers remove the moisture down to about 8 – 10%. This material is then transferred to the rollers which produce a thin film of the carboxylated starch. The next part of the process is the flaking operation which produces a fine flake. Mergal biocide is added at this point to prevent product degradation. The product is gravity fed into storage bags. During this process samples are taken and tested/analysed for quality control purposes. The raw material consumption is complete with no waste arising. The process aims to yield 100% with any reject batches being reused in drilling muds. A process flow diagram is shown in Appendix 3.

2.2.2 Emissions from the dryers have been considered in an Air Quality Assessment which accompanies this application. The assessment of substances and concentrations have been considered in a worst-case scenario. Emissions are vented to atmosphere via a 7.5m high stack.

2.3 HYDROXPROPYL STARCH MODIFICATION

2.4 EXISTING STEAM BOILERS

2.4.1 There are two existing steam boilers on Site, namely a 6,000Kg/hour Yorkshireman 2 boiler and a standby 3,600Kg/hour unit, which is used when the Yorkshireman 2 boiler is off-line for serving, maintenance etc. Both are fired by gas from the national grid and emissions are vented to atmosphere via a 13.5m high stack. Generated steam is used to provide heat to the drum dryers and reactor vessels.

2.4.2 The main Yorkshireman 2 boiler is a high efficiency unit. It is a low NOx unit, designed to meet an emission limit of 100mg/m^3 NOx. During emissions testing of the boiler all firing points were within this threshold, with the highest level of NOx recorded from firing port P13, at 47ppm (i.e. 96 mg/Nm^3), see Appendix 1. Note that additional potential emissions (i.e. sulphur dioxide, carbon monoxide, particulates and carbon monoxide) have been considered in an Air Quality Assessment which accompanies this application.

2.4.3 Due to the high efficiency of the Yorkshireman 2 boiler (95%) and the incorporation of a low NOx system, the unit is considered BAT.

2.5 COMBINED HEAT AND POWER (CHP) PLANT

2.5.1 The CHP Plant may be installed in future years to produce electricity and heat for parasitic use at the

Site. The CHP plant will comprise a new Jenbacher gas engine with a net rated thermal input of 1363Kw/hr. Gas supply to the CHP plant will be from the national grid.

2.5.2 The Jenbacher JMS 312 GS-NL has an electrical output of 526 kW_e and a recoverable heat output of 659 kW_{th}. It is highly efficient, with a manufacturer specified efficiency of 86.9%.

2.5.3 Generated electricity will be used parasitically at the Site to power the plant, whilst recoverable heat will be ducted to a 500kg/hr steam boiler to provide heat to the drum dryers and reactor vessels. Exhaust gases from the CHP plant are discharged to atmosphere via a 15m high exhaust. Exhaust gas temperature is 504°C from the engine, but after passing to the steam boiler is circa 80°C.

2.5.4 Government guidance (https://www.gov.uk/guidance/medium-combustion-plant-mcp-comply-with-emission-limit-values) requires compliance with the emission limits stated in EU Directive 2015/2193 'on the limitation of emissions of certain pollutants into the air from medium combustion plants'. Emissions from the CHP plant are therefore required to comply with EU Directive 2015/2193 Annex II, Part 2, Table 2 emission limit values (mg/Nm^3) for new engines and gas turbines, at a temperature of 273K, a pressure of 101.3 kPa and after correction for the water vapour content of the waste gases and at a standardised O2 content of 15 % for engines and gas turbines. The NOx emission limit for the CHP plant is 95 mg/Nm^3.

2.5.5 The CHP plant meets the latest emission limits requirements of the Environmental Permitting (England and Wales) Regulations 2016, as amended, and the Medium Combustion Plant Directive. The CHP plant has a high level of efficiency (86.9%) and the generated electricity and heat will be parasitically used at the Site. It is therefore considered to be BAT.

Table 2 Emission limit values (mg/Nm^3) for new engines

Pollutant	Type of Medium Combustion Plant	Natural Gas
SO_2	Engines	-
NOx		95 mg/Nm^3
Dust		-

2.5.6 In accordance with EU Directive 2015/2193, Annex III 'Monitoring of Emissions and Assessment of Compliance', it is proposed that CHP gas engine emissions will be:

- monitored at least every three years, i.e. to meet the requirements for medium combustion plants with a rated thermal input equal to or greater than 1 MW and less than or equal to 20 MW); and
- the first measurements shall be carried out within four months of the grant of the Environmental Permit or the operational start date of the CHP plant if commissioned, once the permit has been determined.

2.6 SITE DRAINAGE

2.6.1 Spent scrubber water from the SMCA scrubber is discharged to foul sewer in accordance with a Trade Effluent Discharge Consent issued by Dwr Cymru Cyfyngedig (see Appendix 1). The maximum volume of discharge is $360m^3$ in any continuous 24 hours period and the discharge shall not exceed

4.2 litres per second. Permitted discharge limits are shown in Table 3 below.

2.6.2 The Operator records flow rate daily and monitors trade effluent quality on an annual basis, with the sample sent to an independent UKAS accredited laboratory for analysis. The foul sewer discharge is also periodically monitored by Dwr Cymru Cyfyngedig to check compliance.

2.6.3 All effluent discharges from the manufacturing process are to foul sewer.

2.6.4 Surface water run-off from the external yard area falls to surface water drains which discharge to surface water sewer, which in turn falls to the Redwither Brook. The two discharge pipes to surface water sewer are both are fitted with penstock valves close to and upstream of the discharge points SW1 and SW2 (see Drawing DW02 'Drainage Layout'). In the event of an accidental spillage on Site, the penstock valves would be shut closed to prevent any discharge to the sewer. An H1 Assessment for sewer emission accompanies this application.

Table 3 Trade Effluent Discharge Consent Limits

Parameter	Limit
Flow rate	360m^3 per continuous 24 hours period and 4.2 litres per second
Chemical Oxygen Demand	<3,000 mg/l, expressed as oxygen
Suspended solids	<800 mg/l
Fats, oils and greases	<100 mg/l
Phosphate	<15mg/l
Ammonia	<25mg/l
Sulphate	<500mg/l
Sulphide	<2mg/l

DRAWINGS

Drawing No CE-WH-1801-DW01a	Environmental Permit Boundary Plan	1:1,250 @ A3
Drawing No CE-WH-1801-DW02	Drainage Layout	1:1,250 @ A3

Legend:

Permit Boundary

Consultant:

Crestwood Environmental Ltd

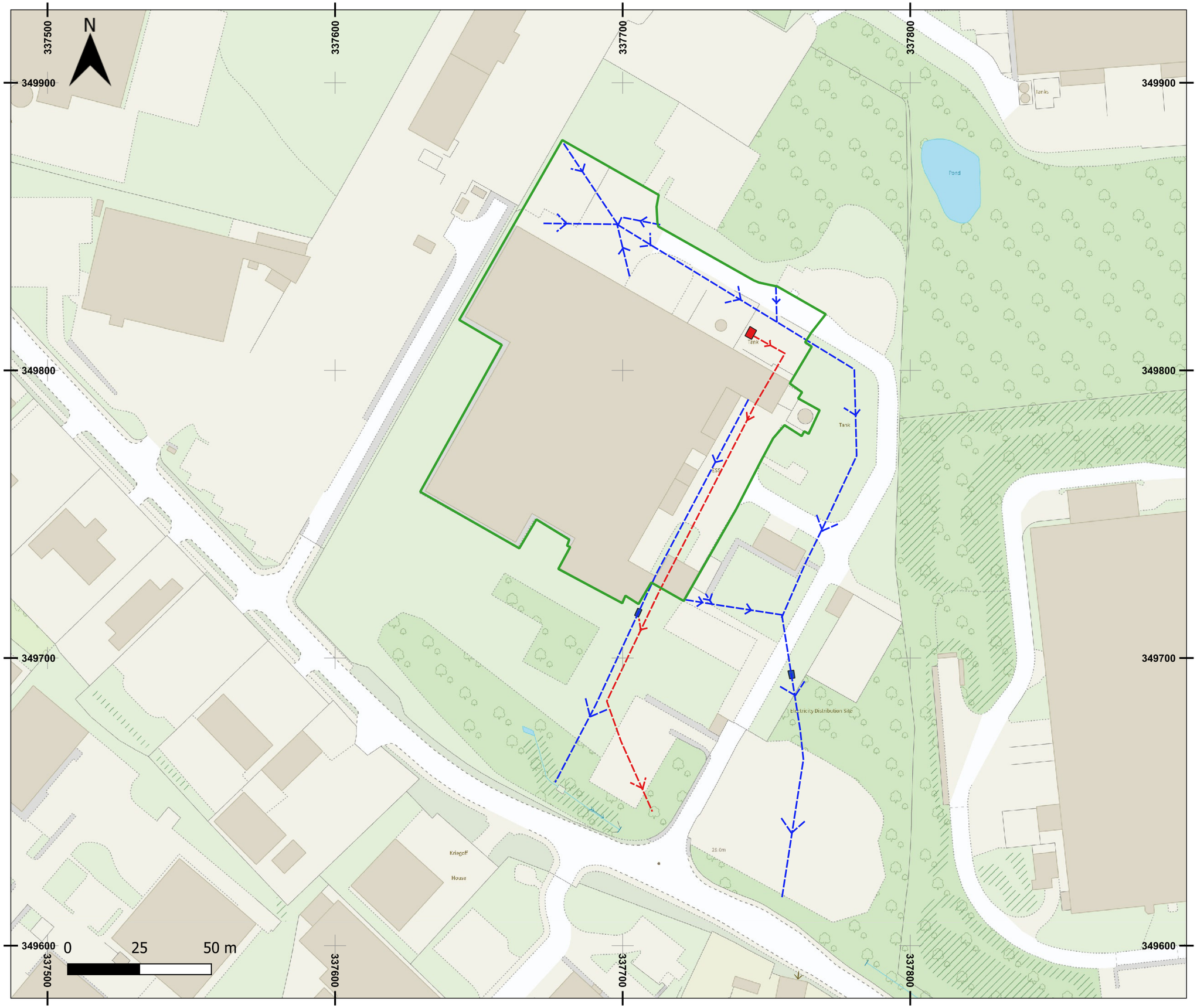
Science, Technology & Prototyping Centre
University of Wolverhampton Science Park
Glaisher Drive, Wolverhampton
WV10 9RU

Tel: 01902 229563
info@crestwoodenvironmental.co.uk
www.crestwoodenvironmental.co.uk

Client:

Novidon

Site: Novidon - Wrexham			
Drawing Title: **Permit Boundary Plan**			
Date: 23 / 2 / 2024	Scale 1:1,250	Paper Size: A3 (420×297mm)	
Drawn By: RM	Checked By: KB	Status: FINAL	Final Revision: a
Drawing Ref: CE-WH-1801-DW01	Drawing No: **Figure 1a**		



Legend:
- Permit Boundary
- Drainage SW
- Drainage (Sewers)
- Penstock Valve

Consultant:
Crestwood Environmental Ltd
Science, Technology & Prototyping Centre
University of Wolverhampton Science Park
Glaisher Drive, Wolverhampton
WV10 9RU

Tel: 01902 229563
info@crestwoodenvironmental.co.uk
www.crestwoodenvironmental.co.uk

Client:
Novidon

Site: Novidon - Wrexham			
Drawing Title: **Drainage Layout**			
Date: 29 / 2 / 2024	Scale 1:1,250	Paper Size: A3 (420×297mm)	
Drawn By: RM	Checked By: KB	Status: FINAL	Final Revision: b
Drawing Ref: CE-MR-1798-DW02	Drawing No: **Drawing 2b**		

APPENDIX 1. TRADE EFFLUENT CONSENT TO DISCHARGE

Consent no: 709008

DWR CYMRU CYFYNGEDIG
WATER INDUSTRY ACT 1991

CONDITIONAL CONSENT TO THE DISCHARGE OF TRADE EFFLUENT TO THE PUBLIC SEWER.
Novidon, Wrexham Industrial estate, LL13 9UH

TO : The Owner of the trade premises (hereinafter called "the Occupiers") whose registered office is situated at **Coed Aben Road, Wrexham Industrial estate, Wrexham, LL13 9UH**

RECITALS.

The **6th August 2018** you applied for consent under Section 119 of the Water Industry Act 1991 for consent to discharge trade effluent from the following trade premises known as **Novidon Ltd** (hereinafter, the Application) and which trade premises are situate at **Coed Aben Road, Wrexham Industrial Estate, LL13 9UH**, for the purpose of identification only shown on the location plan attached hereto and marked "A" (hereinafter, "the said trade premises").

1. Compliance with the conditions hereunder shall be ascertained by reference to the method of analysis as from time to time employed by the Undertaker, its servants, agents or contractors, save where the said condition(s) otherwise expressly provide(s)

DWR CYMRU CYFYNGEDIG ("the Undertaker") in the exercise of its powers under Section 121 of the Water Industry Act 1991, and thinking it fit to impose conditions as hereinafter appear, **GIVES ITS CONSENT** to the discharge of trade effluent from the said trade premises into the Undertaker's public sewers, **SUBJECT TO THE FOLLOWING CONDITIONS AND NOT OTHERWISE.**

(1) The public sewer(s) into which the trade effluent may be discharged is the 225 mm more particularly identified by means of a line(s) coloured RED drawn on the plan attached hereto and marked "B".

(2) The discharge of trade effluent shall be made at the point marked "X" on the said plan and the said trade effluent shall enter into the public sewer shown on the said plan at the point marked "Y" thereon and nor otherwise. Further, no connection, linkage, conduit, pipe, channel or other communication whatsoever shall be made to the said sewer between the said points "X" and "Y" (without the prior approval in writing of the Undertaker).

(3) The trade effluent to be discharged shall consist solely that which is specified in the Application and derived (exclusively) from the refining and drying of potato starch.

(4) Without prejudice to condition 3 above, the nature and/or composition of the trade effluent which may be discharged is as specified in the FIRST SCHEDULE hereto.

(5) The trade effluent shall not include any of the substances or properties listed in the SECOND SCHEDULE hereto in concentration greater than stated therein.

(6) The maximum quantity of trade effluent discharged on any day (being any continuous 24 hour period) shall not exceed **360 cubic metres.**

(7) The highest rate at which trade effluent may be discharged shall not exceed **4.2 litres per second.**

(8) The trade effluent shall only be discharged into the public sewer(s) from 0.00 hours to 2400 hours (on the following days each week, namely Monday to Sunday).

(9) No uncontaminated condensing water shall be discharged.

(10) There shall be eliminated from the trade effluent before it is discharged the matters listed below:

a) Effluent with a temperature in excess of 43° Celsius (110° Fahrenheit);
b) Calcium Carbide;
c) Petroleum Spirit within the meaning of Section 111 of the Water Industry Act 1991, save otherwise permitted herein:
d) Other material forming a constituent of the trade effluent, whether along or in combination with other materials, specified hereby as that which is explosive;
e) Any other substance forming a constituent of the trade effluent which is hereby specified as that which is likely to injure the sewers or to interfere with the free flow of their contents or to affect prejudicially the treatment and disposal of their contents.

(11) No trade effluent shall be discharged the pH value of which is less than **5 or greater than 10.0.**

(12) No trade effluent shall be discharged the nature or composition of which includes a matter, substance, property or matters, substances or properties which would constitute the trade effluent as Special Category Effluent within the meaning of Section 138 of the Water Industry Act 1991.

(13) The Occupier shall give to the Undertaker prior written notice of any change in the process of manufacture, materials, or other circumstances howsoever arising capable of altering the nature and/or composition of the trade effluent. No new substances or properties shall be discharged until the Undertaker has agreed thereto, either with or without imposing a limit and thereafter the said substance(s) and/or property(ies) shall be deemed incorporated into the SECOND SCHEDULE.

(14) An inspection chamber or manhole shall be provided and maintained by the Occupier in a suitable position and/or at the point(s) marked "X" on the plan annexed hereto in connection with each pipe through which the trade effluent is discharged and such inspection chamber or manhole shall be constructed and maintained in accordance with the Undertaker's reasonable requirements as from time to time notified in writing to the occupier so as to enable a person readily at any time to take samples of the trade effluent being discharged.

(15) A notch gauge, continuous recorder or some other apparatus suitable and adequate to the Undertaker for measuring and automatically recording the volume and rate of trade effluent so discharged shall be provided, such apparatus to be tested and maintained in accordance with the Undertaker's reasonable requirements as from time to time notified in writing to the Occupier.

(16) Apparatus capable of accurately determining, measuring and recording the nature and/or composition of the trade effluent discharged shall be provided, such apparatus to be tested and maintained in accordance with the Undertaker's reasonable requirements as from time to time notified in writing to the Occupier.

(17) The Occupier shall keep records of the volume, rate, nature and/or composition of the trade effluent discharged into the sewer(s) at all times available for inspection by any authorised officer of the Undertaker and copes of such records shall be sent to the Undertaker on demand.

(18) (a) The Occupier shall pay to the Undertaker charges for the reception, conveyance, treatment and disposal of the trade effluent and the costs of sampling, measuring and/or analysis of the same under the Undertaker's trade effluent's functions, which charges shall be determined as set out below, and all sums payable under this condition shall be payable upon demand;

(b) The charges under (a) above shall be calculated in accordance with Undertaker's Scheme of Charges as from time to time amended;

(c) For the avoidance of doubt, the charge shall be payable by any person who is or was the Occupier of the said trade premises during the period of discharge of the trade effluent or at the time payment is due.

(19) If the notch gauge, meter, recorder or other apparatus ceases to record or is suspected of not recording and/or measuring accurately, the quantity of trade effluent discharged into the sewer(s) during the period from the date and/or time at which the records were last accepted by the Undertaker as being correct up to the date when the notch gauge, meter, recorder or other apparatus again registers accurately shall for the purpose of any payment to be made under these conditions be based on the average daily volume of trade effluent discharged during the preceding period over which the records were last accepted by the Undertaker as being

accurate or during the month immediately after the notch, gauge, meter, recorder or other apparatus or means of measurement and recording has been accurate whichever is the higher.

YOUR RIGHT OF APPEAL

Any person aggrieved by: -

The refusal of a Sewage Undertaker to give consent for which application has been made to the Undertaker under Section 119 of the Water Industry Act 1991; or

Any condition attached by a Sewage Undertaker to such consent may appeal to the Director General of Water Services.

On an appeal in respect of a refusal to give consent, the Director may give the necessary consent either unconditionally or subject to such conditions as he thinks fit to impose.

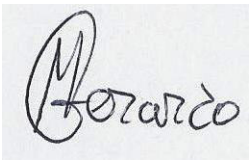
On an appeal in respect of a condition the Director may take into review all the conditions whether appealed against or not and may substitute for them any other set of conditions (whether more or less favourable to the Appellant) or annul any of the conditions and may include provision as to the charges to be made in pursuance of any condition attached to a consent for any period before the determination of the appeal.

On any appeal the Director may give direction that the trade effluent shall not be discharged until a specified date.

FAILURE TO COMPLY WITH CONDITIONS.

If in the case of any trade premises a condition is contravened, the Occupier of the premises will be guilty of an offence and liable on conviction by a Magistrates' Court to a fine not exceeding the statutory maximum or on conviction by the Crown Court to an unlimited fine.

DATED **16 day of August 2018**

For and on behalf of the Company 

(Michael Gerardo)

Designation: _Wastewater Science Manager_

Address of Division:

Northern Division
Dinas Depot
Llanwnda
Caernarfon
Gwynedd
LL54 5UD

FIRST SCHEDULE

(1) Effluent derived from the **washing, refining and drying of potato starch.**

(2) Water (including such elements, compounds and organisms normally present in water at trace or harmless levels and not exceeding such levels that as may be imposed by regulations for the time being regulating the quality drinking water)

SECOND SCHEDULE.

PART A (Applicable to spot samples)

(1) Total suspended solids of the trade effluent shall not exceed **800 milligrams per litre.**

(2) The chemical oxygen demand of the trade effluent after one-hour quiescent settlement shall not exceed **3000 milligrams per litre.**

(3) Fats, Oil sand Greases shall not exceed **100 milligrams per litre.**

(4) Phosphate shall not exceed **15 milligrams per litre**.

(5) Ammonia shall not exceed **25 milligrams per litre.**

(6) Sulphate shall not exceed **500 milligrams per litre**.

(7) Sulphide shall not exceed **2 milligrams per litre**

PART B (Applicable to Composite samples)

(1) Total suspended solids of the trade effluent shall not exceed **800 milligrams per litre.**

(2) The chemical oxygen demand of the trade effluent after one-hour quiescent settlement shall not exceed **3000 milligrams per litre.**

(3) Fats, Oil sand Greases shall not exceed **100 milligrams per litre.**

(4) Phosphate shall not exceed **15 milligrams per litre**.

(5) Ammonia shall not exceed **25 milligrams per litre.**

(6) Sulphate shall not exceed **500 milligrams per litre**.

(7) Sulphide shall not exceed **2 milligrams per litre**

THIRD SCHEDULE

Not applicable.

APPENDIX 2. PROCESS FLOW DIAGRAM - PROPOSED STARCH REFINERY (USING IMPORTED STARCH)

Refinary

Load Big Bags via hoist

Main Mix Tank

Bags mixed with water and stirred - Baume

Rotary Tank

Shaker Sieve

Buffer Tank

Nivoba Rotary Sieve

Bag for Waste

Sand Cyclone

Bag for Sand waste

Tank 4100

Tank 5000

4301 Cyclone

Vacuum Filter A

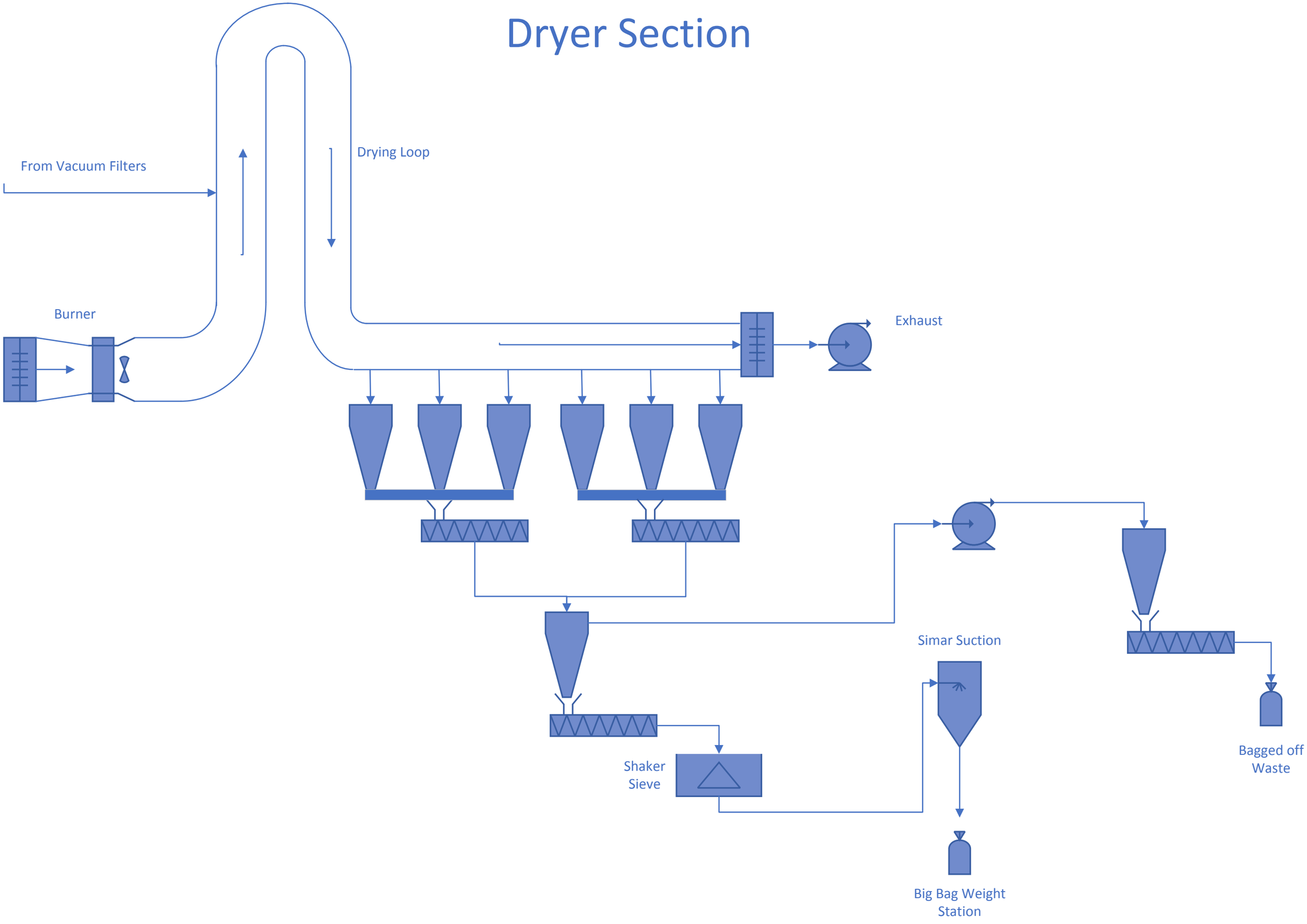
Vacuum Filter B

Water recovery

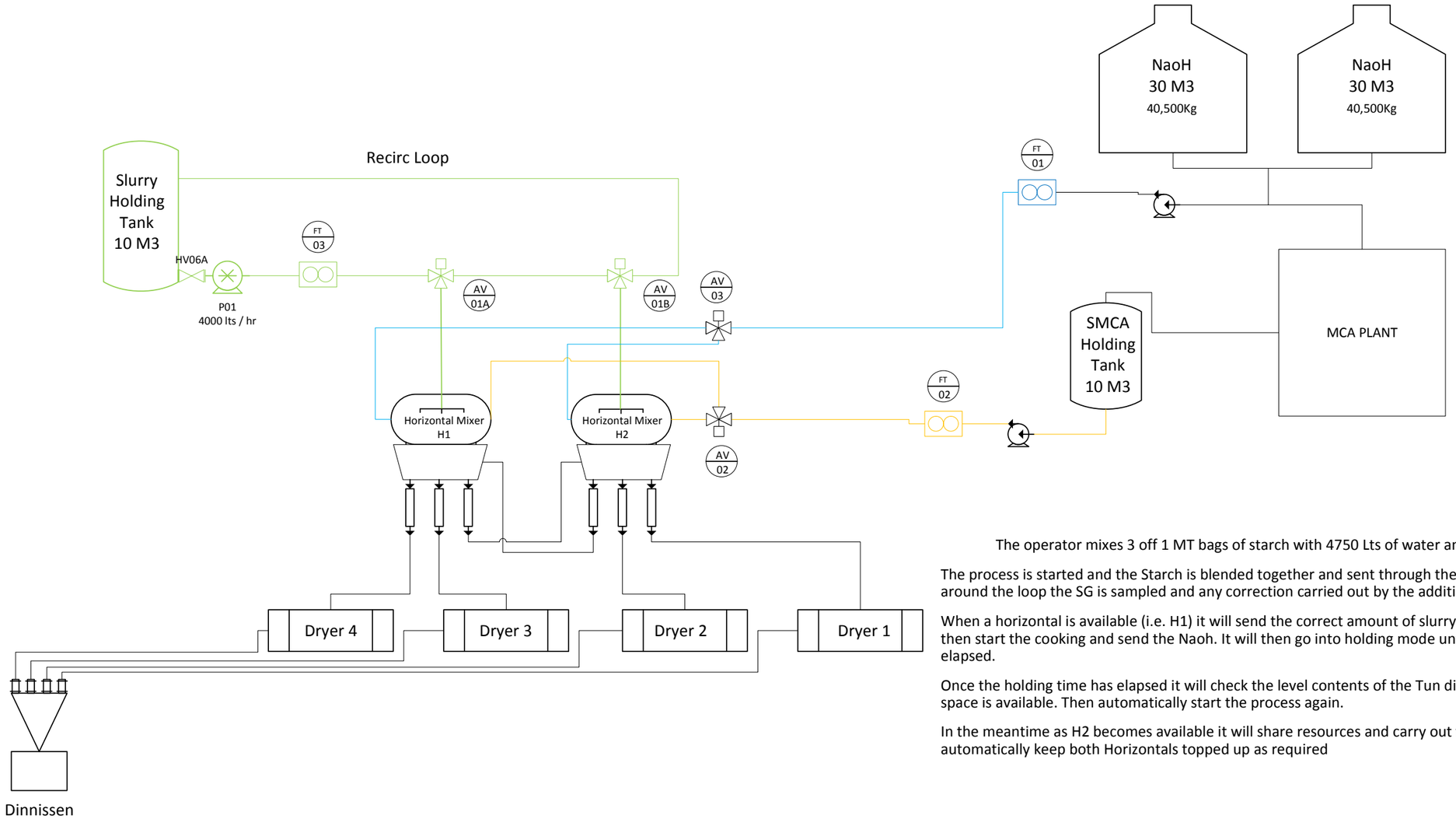
Tank 4003

To Dryer Section

Dryer Section



APPENDIX 3. PROCESS FLOW DIAGRAM - CARBOXYMETHYLISATION STARCH MODIFICATION



The operator mixes 3 off 1 MT bags of starch with 4750 Lts of water and adds the crosslinker

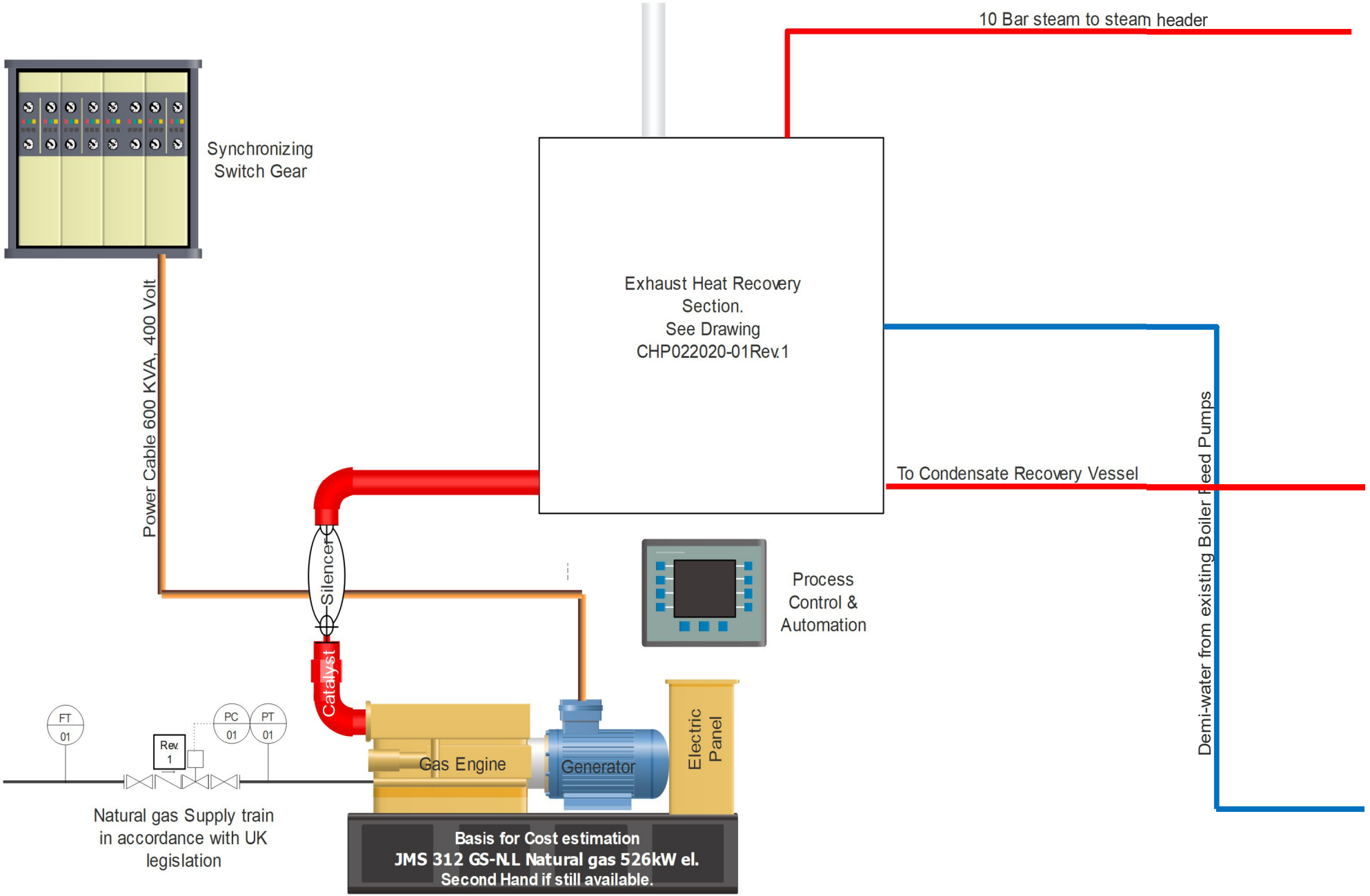
The process is started and the Starch is blended together and sent through the Recirc loop. It circulates around the loop the SG is sampled and any correction carried out by the addition of water. .

When a horizontal is available (i.e. H1) it will send the correct amount of slurry , water and SMCA to H1 , then start the cooking and send the Naoh. It will then go into holding mode until the correct time has elapsed.

Once the holding time has elapsed it will check the level contents of the Tun dish and drop the mix when space is available. Then automatically start the process again.

In the meantime as H2 becomes available it will share resources and carry out the same process into H2 and automatically keep both Horizontals topped up as required

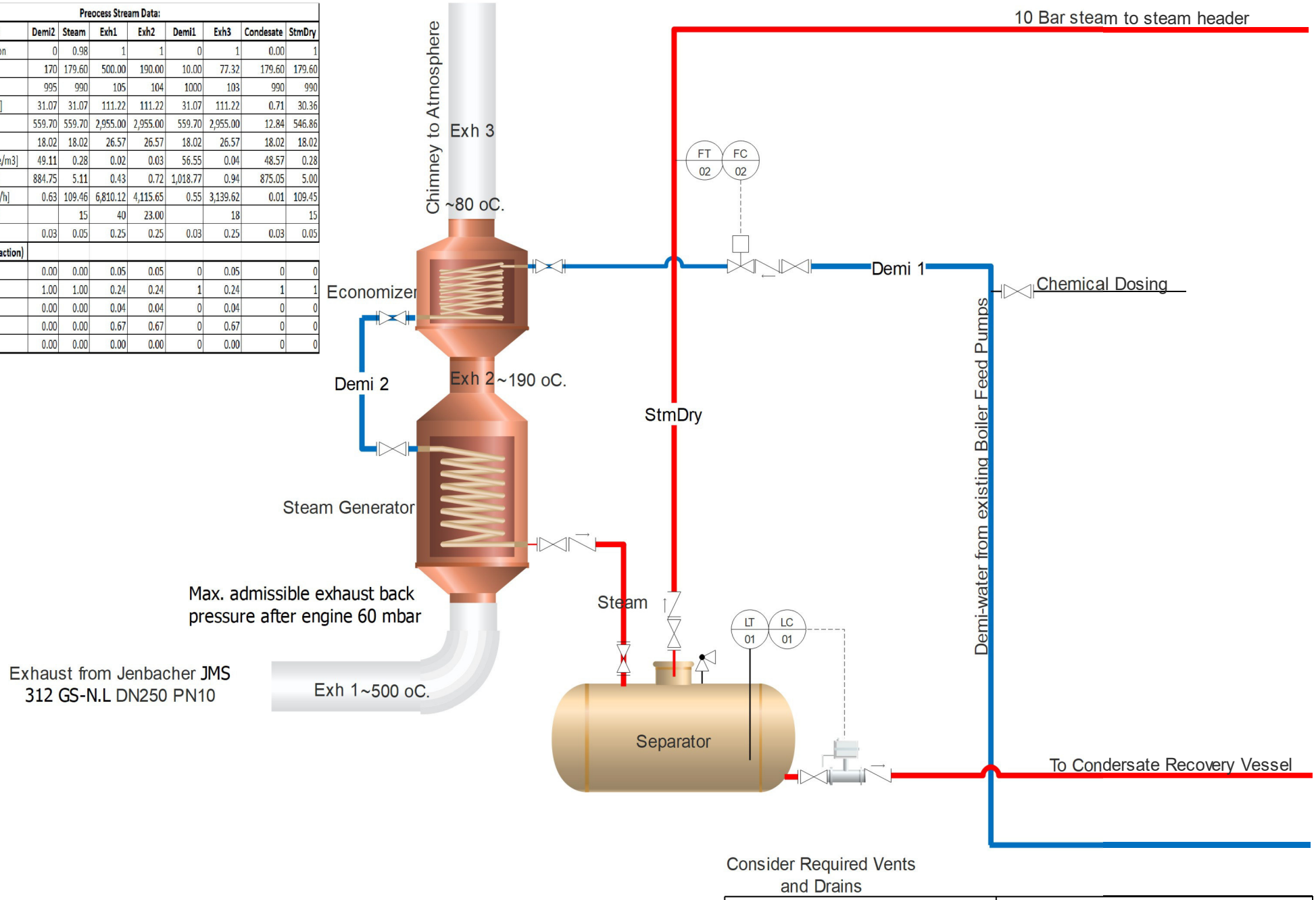
APPENDIX 4. PROCESS FLOW DIAGRAM - CHP PLANT PROCESS FLOW DIAGRAM



Note: LLH decipation / utilization must be discussed. (~300 KWth.)
Heat Level ~ 80 oC.

Novidon Sustainable starch solutions	Process Flow Diagram CHP Wrexham	
	Drawing	CHP012020-01Rev. 1
	Date	July 2020
	Purpose	For Process Design & Cost Estimation

Preocess Stream Data:								
Stream Name	**Demi2**	**Steam**	**Exh1**	**Exh2**	**Demi1**	**Exh3**	**Condesate**	**StmDry**
Vapour / Phase Fraction	0	0.98	1	1	0	1	0.00	1
Temperature [C]	170	179.60	500.00	190.00	10.00	77.32	179.60	179.60
Pressure [kPa]	995	990	105	104	1000	103	990	990
Molar Flow [kgmole/h]	31.07	31.07	111.22	111.22	31.07	111.22	0.71	30.36
Mass Flow [kg/h]	559.70	559.70	2,955.00	2,955.00	559.70	2,955.00	12.84	546.86
Molecular Weight	18.02	18.02	26.57	26.57	18.02	26.57	18.02	18.02
Molar Density [kgmole/m3]	49.11	0.28	0.02	0.03	56.55	0.04	48.57	0.28
Mass Density [kg/m3]	884.75	5.11	0.43	0.72	1,018.77	0.94	875.05	5.00
Act. Volume Flow [m3/h]	0.63	109.46	6,810.12	4,115.65	0.55	3,139.62	0.01	109.45
Pipe velocity: (m/sec)		15	40	23.00		18		15
Pipe size: (m)	0.03	0.05	0.25	0.25	0.03	0.25	0.03	0.05
Composition: (Mol Fraction)								
CO2	0.00	0.00	0.05	0.05	0	0.05	0	0
H2O	1.00	1.00	0.24	0.24	1	0.24	1	1
Oxygen	0.00	0.00	0.04	0.04	0	0.04	0	0
Nitrogen	0.00	0.00	0.67	0.67	0	0.67	0	0
NO2	0.00	0.00	0.00	0.00	0	0.00	0	0



Novidon Sustainable starch solutions A ROYAL COSUN COMPANY	**Process Flow Diagram CHP Wrexham HRS**
Drawing	CHP022020-01Rev.1
Date	July 2020
Purpose	For Process Design & Cost Estimation