RISK & HAZARD MANAGEMENT

012 - Technical Description of Activities

Saffil Ltd (also known as Unifrax/Alkegen)
Line 4 Permit Variation

Document History

Version	Issue	Date	Notes	Author	Reviewer
1	-	23/03/22	Working draft with client	J. Carroll R. Nibbs	C. Nicholls
2	1	14/07/22	Issue as part of permit application	J. Carroll R. Nibbs	C. Nicholls R. Ritchie R. Nibbs

Contents

1 Introduction

This document provides the information required on Form C3 Appendix 2.

Please note that this document refers to the site as Unifrax Widnes and to the owning company as Unifrax. Unifrax was the name of the American company that owns Widnes site. A further complexity is added because due to a recent merger, Unifrax has changed its name to Alkegen. So, it is possible in correspondence or discussions that the site may be referred to as Alkegen.

The legal entity that owns the site at Widnes is however called Saffil Ltd and remains so despite the name changes to Unifrax and now Alkegen – and it is in this name that the EPR application is made on the accompanying forms.

1.1 Site History

The 'Saffil' fibre production lines at Widnes site are the last operating assets on an Imperial Chemical Industries (ICI) site called Pilkington Sullivan site that operated for decades. All other assets are demolished. In common with other large sites in the area, legacy ground contamination issues remain.

Line 1 was started up in 1978 and has not operated since it was shut down at the end of 2018. It is proposed that this will be removed from the EPR permit following EA approval of this application.

Line 2 was started up in June 2004. Line 2 includes BAT gaseous abatement plant for destruction of VOCs and dioxins generated during the heat treatment of raw fibre.

Line 3 was started up in April 2013 and is housed in a building to the south of the site. Line 3 also includes BAT gaseous abatement plant for destruction of VOCs and dioxins generated during the heat treatment of raw fibre.

A gas fired dual boiler facility with diesel back up fuel was installed under the EPR permit granted in 2012 to supply steam to the production lines.

This permit variation application covers the following changes on the site:

- Formal removal of Line 1 from the permit as a fibre manufacturing unit. It has not run since its shutdown in late 2018.
- Retention of fibre handling, shredding/baling and reeling equipment associated with Line 1 to allow off-line processing of fibre.
- A new fibre production line (Line 4) with capability to make silica fibre in addition to Saffil and M-Fil fibre, located next to the current Line 3 in an extended building.
- Upgrade of infrastructure, including additional steam raising and compressed air capacity to service the new line.

The new production line (Line 4) will be capable of making all the existing grades of fibre currently made on Lines 2 and 3.

Line 4 will also be capable of making a new, predominantly silica (silicon dioxide) fibre (henceforward referred to as silica fibre).

1.2 Purpose of Project

Current production from Widnes serves a wide range of customers in industrial and automotive applications. Most customers are overseas. The site therefore serves as a major exporter and local employer.

Typical industrial applications include furnace linings and modules, specialist refractory boards and shapes and filtration applications. This together with other specialist markets.

Automotive applications form a larger part of the overall volume with the main application being gaskets in catalytic converters (autowraps). Fibre from Widnes is exported to sister factories in North Wales and South Africa for conversion into autowraps using a wet laid process. It is also supplied to other customers who operate similar processes. Other automotive applications include heat protection, battery separators, metal matrix reinforcement and diesel particulate filters.

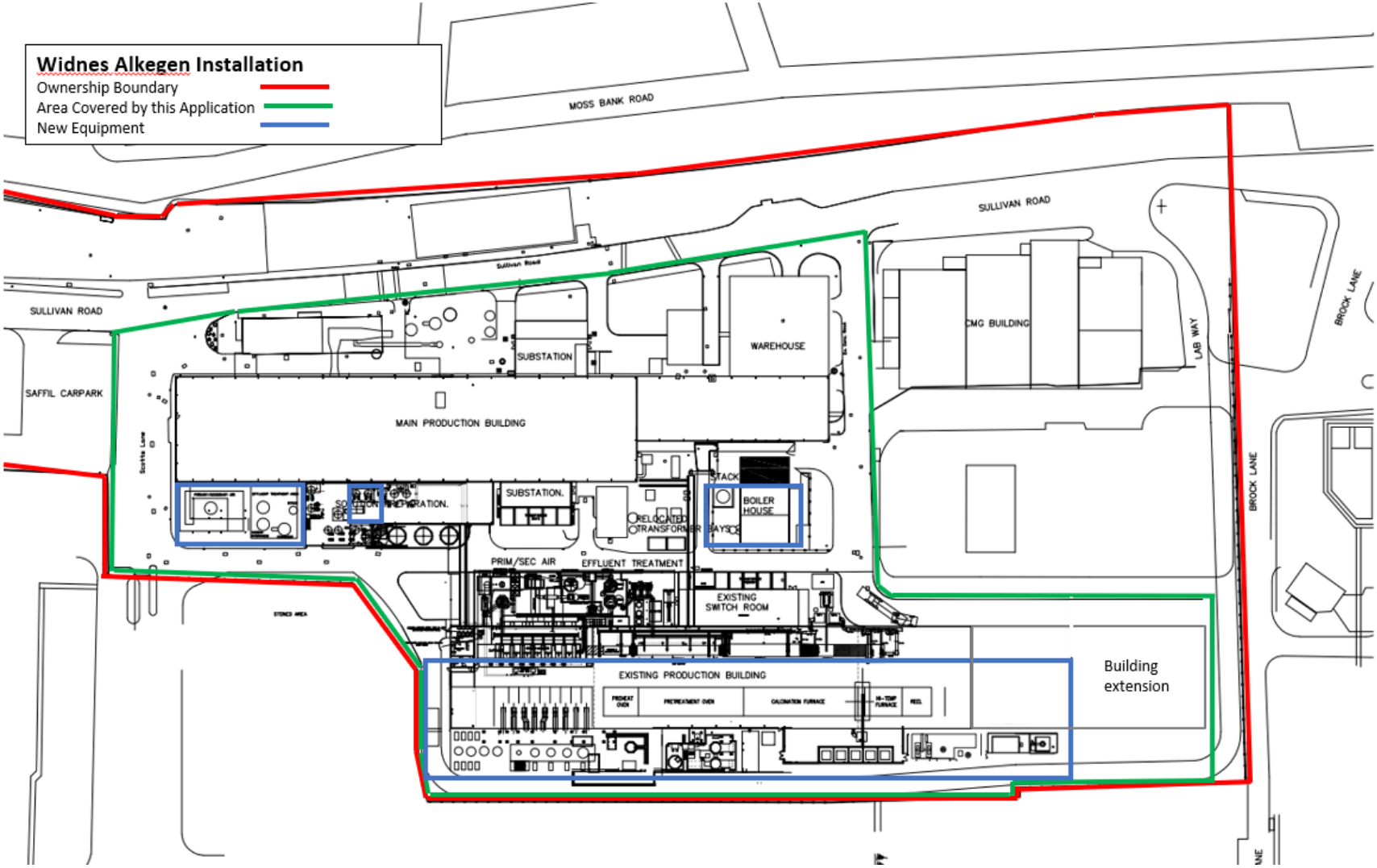
Line 4 is being built to service demand for SiFAB™, a new silicon fibre product developed by Unifrax for use as an anode material in Lithium ion rechargeable batteries. SiFAB™ offers significant advantages in charge density and physical size due to its chemistry and is a very significant opportunity to improve, for example, portable battery life, electric vehicle range and reduce weight in hand-held devices.

SiFAB™ is a pure silicon fibre made by converting the silica fibre made at Widnes into the required silicon fibre by chemical reduction. The first commercial production line for SiFAB™ is currently in construction in Indiana, USA. Silica fibre from Widnes will be exported from Line 4 to this facility for conversion into SiFAB™.

Line 4 will also have capability to make other Saffil and M-Fil fibres in order to fill capacity and maintain sales revenue as the market for SiFAB™ develops

2 Site layout

The overall site layout is shown in Figure 1 Widnes Installation - Layout below.


Widnes Alkegen Installation
Ownership Boundary
Area Covered by this Application
New Equipment
MOSS BANK ROAD
SULLIVAN ROAD
SULLIVAN ROAD
SAFFIL CARPARK
SUBSTATION
WAREHOUSE
CMG BUILDING
LAB WAY
BROCK LANE
MAIN PRODUCTION BUILDING
SUBSTATION.
STACK
BOILER HOUSE
RELOCATED TRANSFORMER BAYS
PRIM/SEC AIR
EFFLUENT TREATMENT
EXISTING SWITCH ROOM
EXISTING PRODUCTION BUILDING
Building extension
BROCK LANE

3 Process chemistry/emissions overview

The manufacturing process for Saffil, M-Fil or Silica fibres involves the blending of aluminium and silicon salt species and other organic species into a spinning solution. There are no chemical reactions during the preparation of the spinning solution.

The spinning solution is then processed in fibre spinning equipment to make raw fibre which is laid down on a collection belt. A small amount of hydrogen chloride gas is released in this process.

The raw fibre is then processed through belt fed ovens and furnaces to temperatures of up to 1400°C. The temperature profile is critical to ensure full chemical conversion of the raw fibre but also to determine final fibre properties.

The reactions during the conversion of raw fibre to Saffil, M-Fil or Silica fibre are:

- firstly a thermal decomposition of aluminium chlorohydrate and siloxane or silica sol to oxides,
- secondly a high temperature conversion of the oxide to the required crystalline form.

During the thermal decomposition of the feed materials, there are released a variety of organic decomposition products. These include low molecular weight chlorinated and unchlorinated hydrocarbons and carbon oxides. Hydrogen chloride is also made in the process due to the decomposition of aluminium chloride species to oxide.

An extremely small amount of dioxins and furans are made in the process – thought to be due to the action of free chlorine radicals on organic species during the thermal decomposition.

Silica fibre spinning solution contains a much lower ratio of alumina when compared with Saffil and M-Fil because the finished fibre contains mostly silica. Less aluminium chlorohydrate is used in the manufacture and it is therefore expected that the emission rate of hydrogen chloride in the process will be significantly lower in the manufacture of silica fibre than in Saffil or M-Fil fibres.

Hydrogen chloride emissions are treated by water scrubbing in dual scrubbers. Scrubber liquor is neutralised using caustic soda prior to release to industrial sewer. Organic and dioxin emissions are treated using a regenerative thermal oxidiser prior to scrubbing.

Fibre can give rise to particulates during product handling or in-process. Dust extraction is important to maintain a safe working environment and these emissions are collected and treated in ceramic or bag type filters depending on the source.

4 Process overview

4.1 Fibre production

Production of fibres at Widnes Site is classed in Schedule 1 Section 4.2 Part A1 (b) in The Environmental Permitting (England and Wales) Regulations as “a manufacturing activity ...which is likely to release into the air any ...hydrogen halide...”. The plant is currently regulated under the Environmental Permitting Regulations Permit EPR/XP3533CB/V002 as varied.

Lines 2 and 3 are currently operating under the permit as above following the granting of a significant variation to the EPR permit XP3533CB granted in May 2012.

Line 1 is shut down and will not be returned to service, although off-line fibre shredding and re-packing facilities previously associated with Line 1 will be retained.

This application covers the addition of a third production line (Line 4). The production line is very similar in nature and technology to the existing lines but has some differences in spinning solution composition, heat treatment and product handling. It comprises:

- Raw Materials Delivery
- Mixing (Solution Preparation)
- Spinning Section
- Primary Air
- Secondary Air
- Heat treatment (primarily direct or indirect gas-fired)
- Reeling Machine and fibre baler (Saffil and M-Fil fibre)
- Line 4 - additional Silica Fibre product handling
- Fibre picker
- Fibre chopper
- Jet mills (x2) including a compressed air supply
- Big bag packaging unit
- Dust extraction and filtration equipment
- Atmospheric emissions abatement and effluent treatment
- Utilities
- Instrument Air
- Mains Water Supply – process water
- Cooling Water
- Steam – gas fired boilers (with diesel back up fuel)
- Dust Extraction and Abatement
- Product Storage and Handling
- Additional facilities, previously associated with Line 1, are to be retained to allow off-line fibre processing and packing:
- Fibre shredder
- Baling machine
- Reeling machine
- Dust extraction and filtration equipment

There are no changes to Lines 2 and 3 proposed under this variation application.

The additional environmental impact from Line 4 when compared with previous site operation of three lines including Line 1 is expected to be insignificant and will be demonstrated in the documentation supporting this application.

On Line 4, refractory alumina-silicate fibres will be made to a number of different grades depending both on composition and fibre properties.

A typical Saffil or M-Fil fibre composition could be expected to vary between 70% and 96% alumina, 30% to 4% silica. Fibre composition is controlled by the ratio of aluminium and silicon species in the raw materials used at the mixing (solution preparation) part of the process.

Fibre properties are controlled depending on composition but also by how the fibre is processed, particularly the heat treatment temperature profile.

Silica fibre will be different in composition (typically 90 – 92% silica, 10-8% alumina) requiring raw materials in different ratios. The process for making silica fibre is however essentially the same as for 'Saffil' type fibres, although there are some differences in the process settings for raw fibre production and heat treatment. Additional equipment will also be needed for silica fibre production in material handling and dust extraction.

Simplified overall block flow diagrams of the two existing operational lines are presented in Figures 1 and 2 below showing the main process stages, the emission points to air, trade effluent and river along with any associated abatement plant. The limited equipment proposed to be retained on Line 1 is indicated on Figure 3.

Figures 4 and 5 show the proposed block diagrams for Line 4.

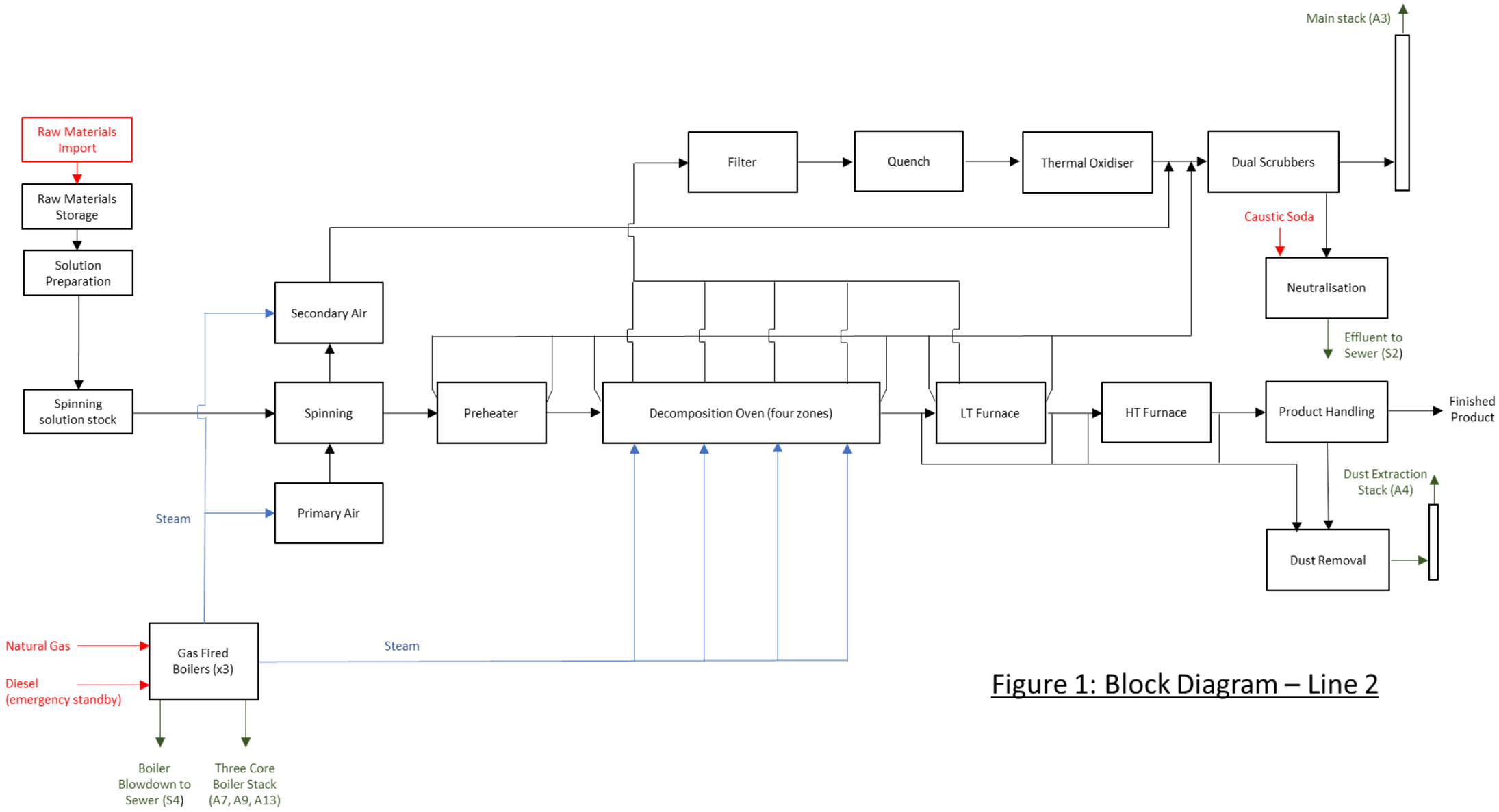


Figure 1: Block Diagram – Line 2

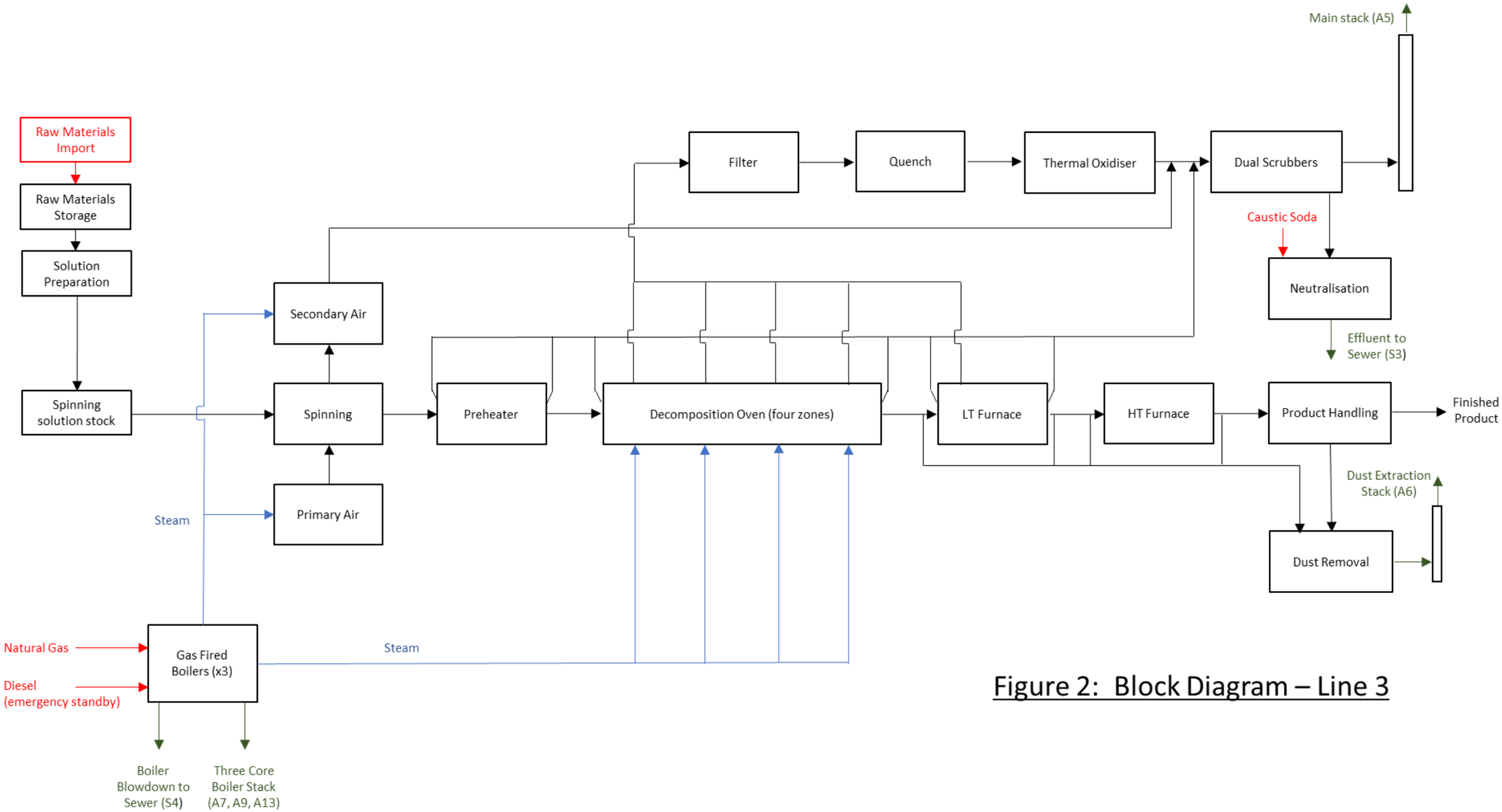


Figure 2: Block Diagram – Line 3

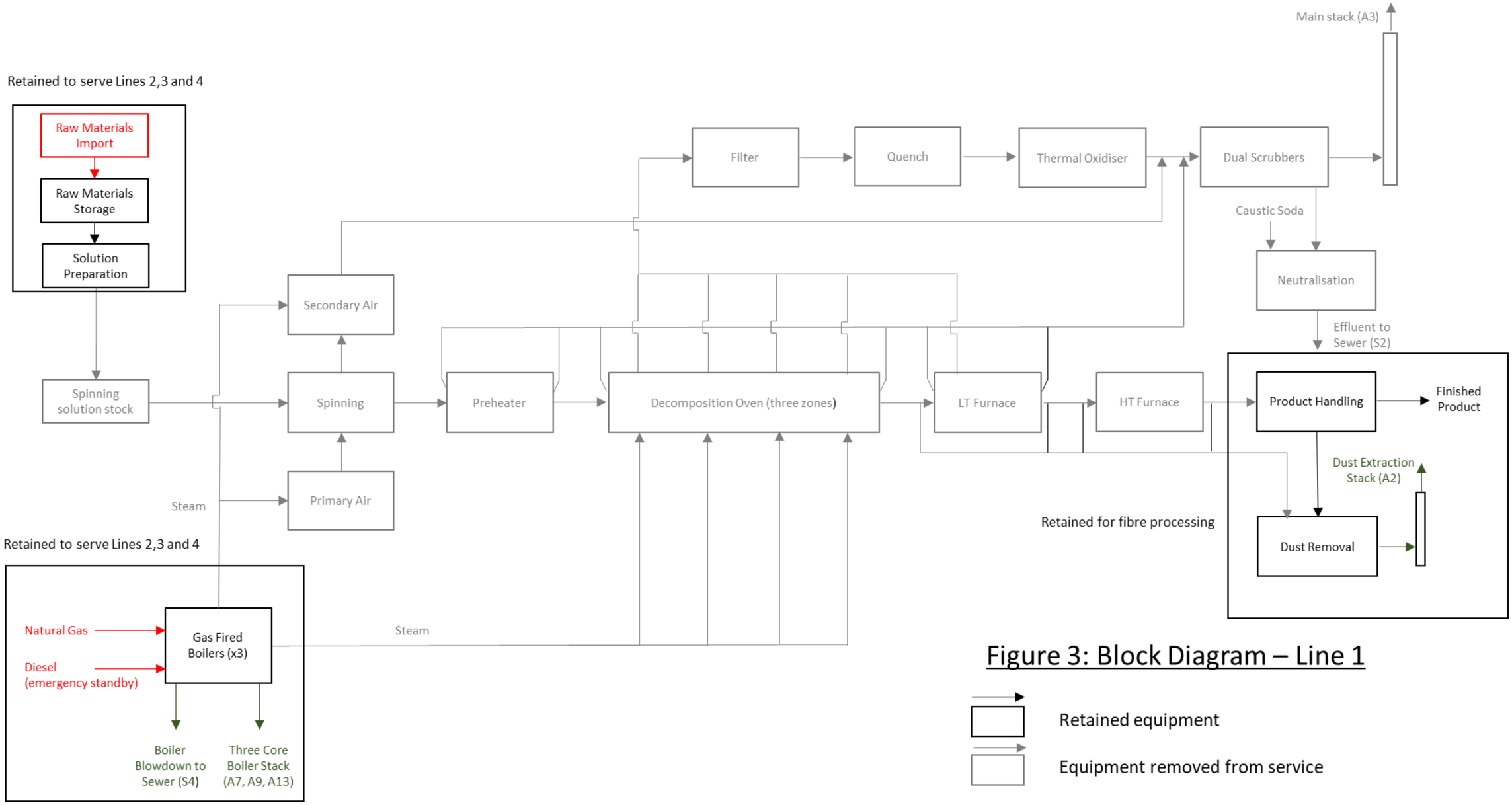


Figure 3: Block Diagram – Line 1

Retained equipment

Equipment removed from service

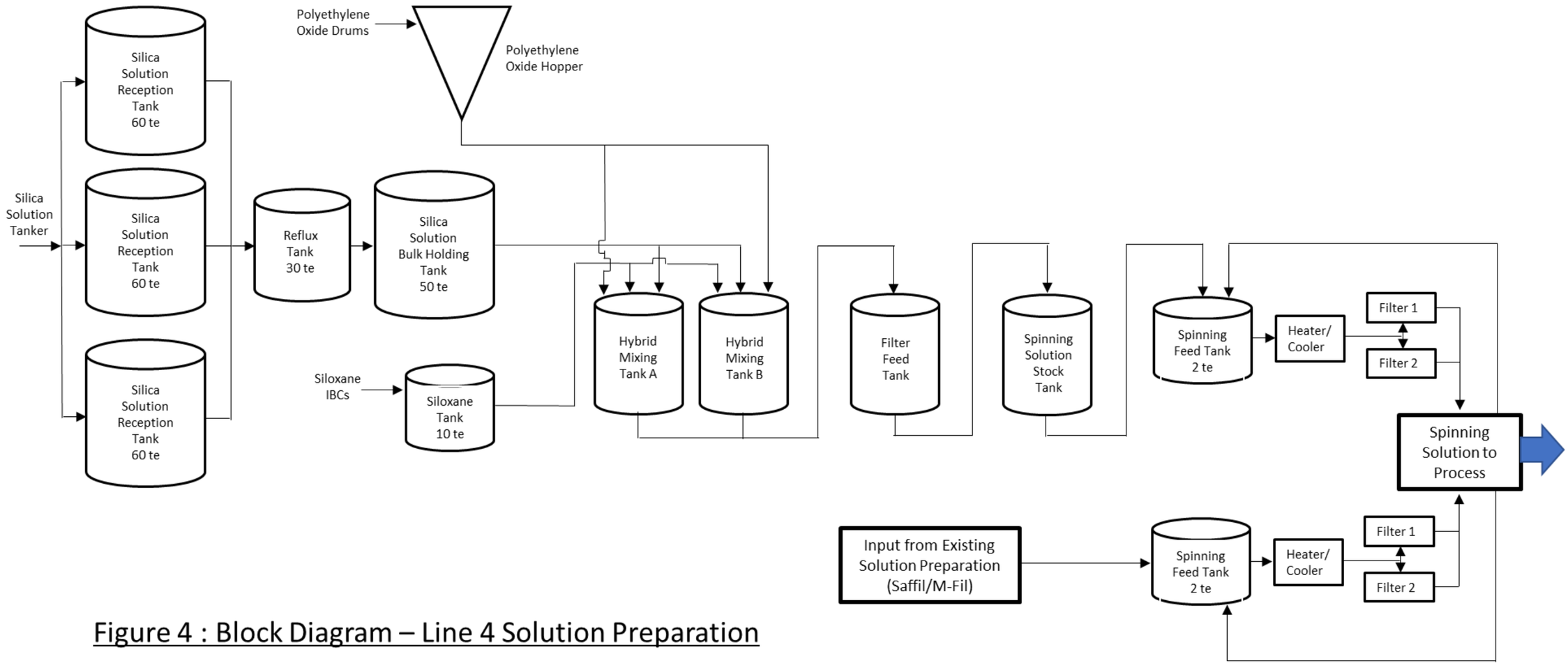
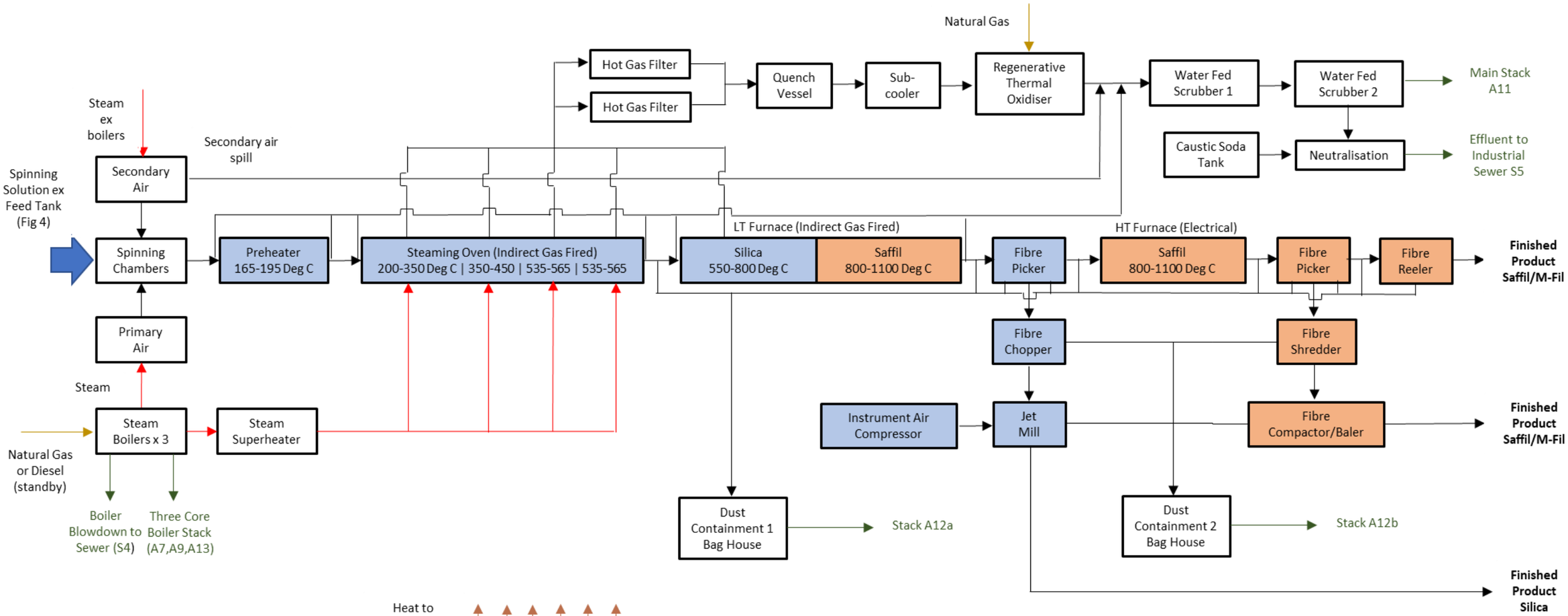
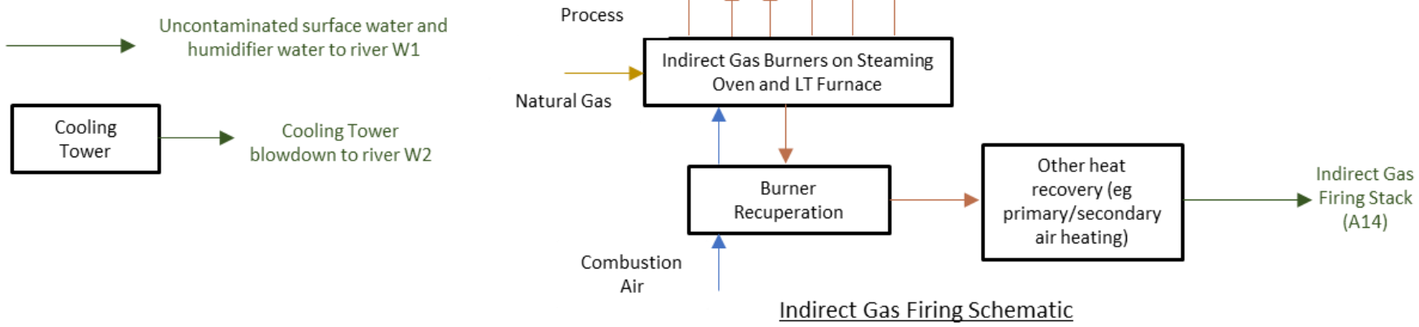


Figure 4 : Block Diagram – Line 4 Solution Preparation





Indirect Gas Firing Schematic

Figure 5 : Block Diagram – Line 4

Legend

- Base heat treatment and product handling for silica fibre
- Additional equipment for Saffil/M-Fil
- Common equipment for both silica and Saffil/M-Fil
- Effluent streams to air and water (green)

5 Process Outline

5.1 Line 4 Production

On Line 4, refractory alumina-silicate fibres will be made to a number of different product grades. These grades vary both in chemical composition and fibre properties.

A typical Saffil or M-Fil fibre composition varies between approximately 70% and 96% alumina, 30% to 4% silica. Fibre composition is controlled by the ratio of aluminium and silicon species in the raw materials used in the mixing (solution preparation) part of the process.

Fibre properties are controlled depending on chemical composition but also by how the fibre is processed, particularly the thermal processing of the fibre in furnaces and ovens after the raw fibre has been spun.

Silica fibre will be different in composition (typically 90 – 92% silica, 10-8% alumina) requiring raw materials to be mixed in different ratios within solution preparation. The process for making silica fibre is essentially the same as for Saffil and M-Fil fibres, although there are some differences in the process settings for raw fibre production and heat treatment. Additional equipment will also be needed for silica fibre production in material handling and dust extraction.

5.2 Line 4 - Process Overview and Introduction

Line 4 will be capable of making Saffil and M-Fil fibres, in common with Lines 2 and 3 but also have the capability to make Silica fibre.

The raw materials aluminium chlorohydrate, a siloxane or silica solution preparation and organic polymer spinning aid are mixed in the required ratios at atmospheric pressure and ambient temperature, and filtered to give the final solution for the process.

The solution is extruded to form fibre in a set of spinning chambers in a warm stream of air and the fibres produced are collected by filtering the drying air through a fine mesh conveyor to form a fibre mat.

At least nine spinning chambers will be installed, giving a 12.5% increase in capacity vs the current eight chambers on Lines 2 and 3 for Saffil and M-Fil grades. The silica fibre production rate per chamber is currently less than Saffil/M-Fil. It may therefore be necessary for more chambers to be installed for silica fibre production to match overall output on Saffil/M-Fil. The drying air is recycled and reheated. Any excess air is fed to the water scrubber.

The mats from successive chambers are laid down on top of each other onto a variable speed collecting conveyor ready for heat treatment.

Heat treatment is carried out in a series of ovens and furnaces, progressively raising the temperature from 100 to 1400^{o}C. Gases emitted from stages 1 to 3 of the heat train

(preheating oven, steaming oven, low temperature furnace) are fed to the vent treatment section followed by discharge via a vent stack.

A further furnace (High Temperature furnace) is included for production of Saffil and M-Fil fibres only, it is not needed for Silica fibre production.

The heat treated Saffil or M-Fil mat is reeled to give a rolled product or shredded and baled to give a bagged product. The Silica fibre is picked, shredded and milled to give a bagged product.

Air from extract hoods on the HT furnace is discharged to atmosphere via a dust extraction unit and stack which also serves the dust extraction duty for the rest of the line including the reeling machine and baler.

Air from extraction hoods and connections on the picking, shredding, milling and bagging area used on silica fibre is discharged to atmosphere via a separate dust extraction unit and stack.

The following sections of this report cover each of the stages of fibre manufacture on Line 4 in detail.

A description of the proposed changes to services infrastructure is also summarised later in the report.

6 Process Description

6.1 Raw materials and storage

The raw materials used on Line 4 for Saffil, M-Fil or Silica fibre production are:

- Aluminium chlorohydrate solution and solid
- Siloxanes or silica solution
- Silcolapse foam inhibitor
- Polyethylene Oxide (PEO)
- Sodium Hydroxide (25% w/w aqueous solution)

Raw materials are covered in detail in section 009 – Raw Materials.

Aluminium chlorohydrate solution, sodium hydroxide, silica solution and siloxanes are stored in bulk tanks. The remainder are stored in the suppliers' containers in a bunded storage area.

Sodium hydroxide, silica solution and aluminium chlorohydrate storage tanks are external and bunded to give 110% containment. All other tanks are contained inside buildings with containment in excess of 110%; in the event of any tank failure.

The principal raw material for silica fibre is silica solution, a non-hazardous aqueous colloidal silica suspension.

The principal raw material for Saffil/MFil fibres is aluminium chlorohydrate (ACH) solution, a low hazard aqueous aluminium salt solution. ACH solid (made from dried ACH solution) is also used in some Saffil spinning solution formulations to ensure the correct alumina ratios are achieved.

Aluminium chlorohydrate and silica solution or siloxane are blended in different ratios to achieve the required alumina:silica ratio in the finished fibre. PEO is used in order to add visco-elasticity to allow the solution to be spun into fibre.

Aluminium chlorohydrate solution is supplied to site by road tanker and off-loaded into three large bunded storage tanks.

Aluminium chlorohydrate solid is supplied in polypropylene big bags and stored in the raw materials building.

PEO is stored inside in cardboard drums.

Siloxane compounds, used as the source of silica for Saffil and M-Fil fibres, are supplied in drums and stored in a bunded storage area. They are emptied in ratio into a bulk storage tank.

Silica solution is supplied by tanker and offloaded into a bulk storage tank or directly into a reflux tank. It can also be supplied in plastic IBCs. The material is refluxed prior to use and transferred to bulk storage.

Caustic soda is used as a neutralising agent for acidic effluent from the scrubbers, and is supplied to site by road tankers and offloaded into a bunded storage tank serving each production line.

The raw materials used for Saffil, M-Fil and silica fibre production are summarised below:

Table 1 Raw materials

Material and spec	Use	Saffil	M-Fil	Silica	Storage
Aluminium chlorohydrate solution (max 58% w/w)	Raw material converted to finished product	Yes	Yes	Possible	Bulk tanks – bunded Recent upgrade to offer 110% containment
Aluminium chlorohydrate solid (flake/powder)	Raw material converted to finished product	Yes	Yes	No	Big bags and storage hopper within contained building
Max 40% w/w Silica solution (colloidal silica in water)	Raw material converted to finished product	No	Yes	Yes	Bulk tanks – bunded to 110% containment
Siloxane (organic silica compound)	Raw material converted to finished product	Yes	Yes	Yes	Drums, IBCs and storage tanks – bunded to 110% containment
Spinning Aid Polyethylene Oxide powder (PEO)	Raw material – spinning aid – removed in process	Yes	Yes	Yes	Drums and storage hopper within contained building
Silcolapse (foam inhibitor)	Raw material – foam inhibitor – removed in process (very low usage)	Yes	No	No	Kegs within contained building

Other materials used in utilities and steam production are:

Table 2 Other materials

Material	Use	Storage
25% w/w caustic soda	Neutralising agent for scrubber liquor	Carbon steel bulk tanks – bunded to 110% containment
Cooling tower chemicals	Legionella compliance and scale reduction in cooling tower	Self-bunded dosing plastic tanks - indoors
Boiler dosing chemicals	Corrosion and scale inhibitors, alkalinity adjustment	Self-bunded plastic dosing tanks - indoors
Natural gas	Steam raising in gas fired boilers Heat treatment ovens and furnaces (Line 4)	Pipeline
Diesel	Emergency back-up fuel – boilers Diesel operated pumps – fire suppression system Fork lift truck fuel	Self-bunded steel storage tanks (x3)

The raw materials used to make Silica, Saffil or M-Fil fibres are generally low hazard to personnel and the environment.

All materials and chemicals are stored, located and managed such that environmental risks are minimised. Loading and unloading are covered by detailed operating procedures ensuring that losses are minimised. The drains serving the area are sealed during transfer operations (e.g. tanker offloading) to ensure any spillage cannot enter controlled waters and the tanks have high level trips and alarms.

Product and packaging materials are stored in warehouse buildings on the site.

6.1.1 Raw Materials Usage

Annual raw materials usages vary depending on the product being made. The maximum estimated annual usages of each raw material are shown in the table below:

Table 3 Raw materials usage

Raw Material	Form	Storage	Maximum Estimated Annual Usage (te/yr)
Aluminium Chlorohydrate solution	Max 58% w/w aqueous solution	Bulk tanks	10,000
Silica solution	Max 40% w/w aqueous solution	Bulk tanks	5,500
ACH flake/powder	Solid	Big bags	2,000
Polyethylene Oxide (PEO)	Solid	Cardboard drums	180
Siloxane (organic silicon material)	Liquid (25% silicon)	Metal drums	570
Silcolapse (foam inhibitor)	Liquid	Plastic drums	20
Caustic soda	25% w/w aqueous solution	Bulk tanks	5,000

A storage facility will be installed to receive deliveries of raw materials for silica fibre manufacture on Line 4 as follows:

Table 4 Raw materials storage

Tank	Concentration (%w/w)	Capacity (te)	Notes
Silica solution	Max 40	60	Supplied by tanker or IBC
Silica solution	Max 40	60	Supplied by tanker or IBC
Silica solution	Max 40	60	Supplied by tanker or IBC
Siloxane	100	10	Supplied by IBC
Caustic soda	25	25	Supplied by tanker
Polyethylene oxide	100	N/A	Stored inside in cardboard drums
Silcolapse	100	N/A	Stored inside in plastic kegs

Facilities for the import and treatment of silica solution consist of three bulk reception tanks, a reflux tank and a holding tank with associated dual pumping equipment. The reflux vessel includes the facility for heating and cooling the silica sol using steam and cooling water within a jacket.

6.2 Solution preparation

Spinning solution is prepared to make either Saffil, M-Fil or silica fibres.

Line 4 is capable of making all three fibres and has additional equipment to allow manufacture of spinning solution for silica fibre spinning.

The solution preparation steps common to all production lines for the manufacture of Saffil fibre are as follows (shown in Figure 1):

- Aluminium chlorohydrate solution is pumped from tanks T104A, B and C to a high shear mixer (T111) where polyethylene oxide, and an antifoam agent are blended in.
- The blended solution is transferred to the dissolver tanks (T112 series)
- Aluminium chlorohydrate solid is transferred into the dissolver tanks via a weigh vessel and flowmeter.
- Siloxanes are pumped from drums into a storage and blending tank T105 and from there into the dissolver tanks via a flowmeter.
- Mixing is completed in the dissolver tanks and the solution pumped forward into the filter feed tanks (T113 series).
- The solution is pumped from the filter feed tanks through filters to the spinning solution stock tanks (T114 series).
- The solution is transferred from the solution stock tanks to the spinning solution feed tanks (T202/602 series) serving the spinning section.

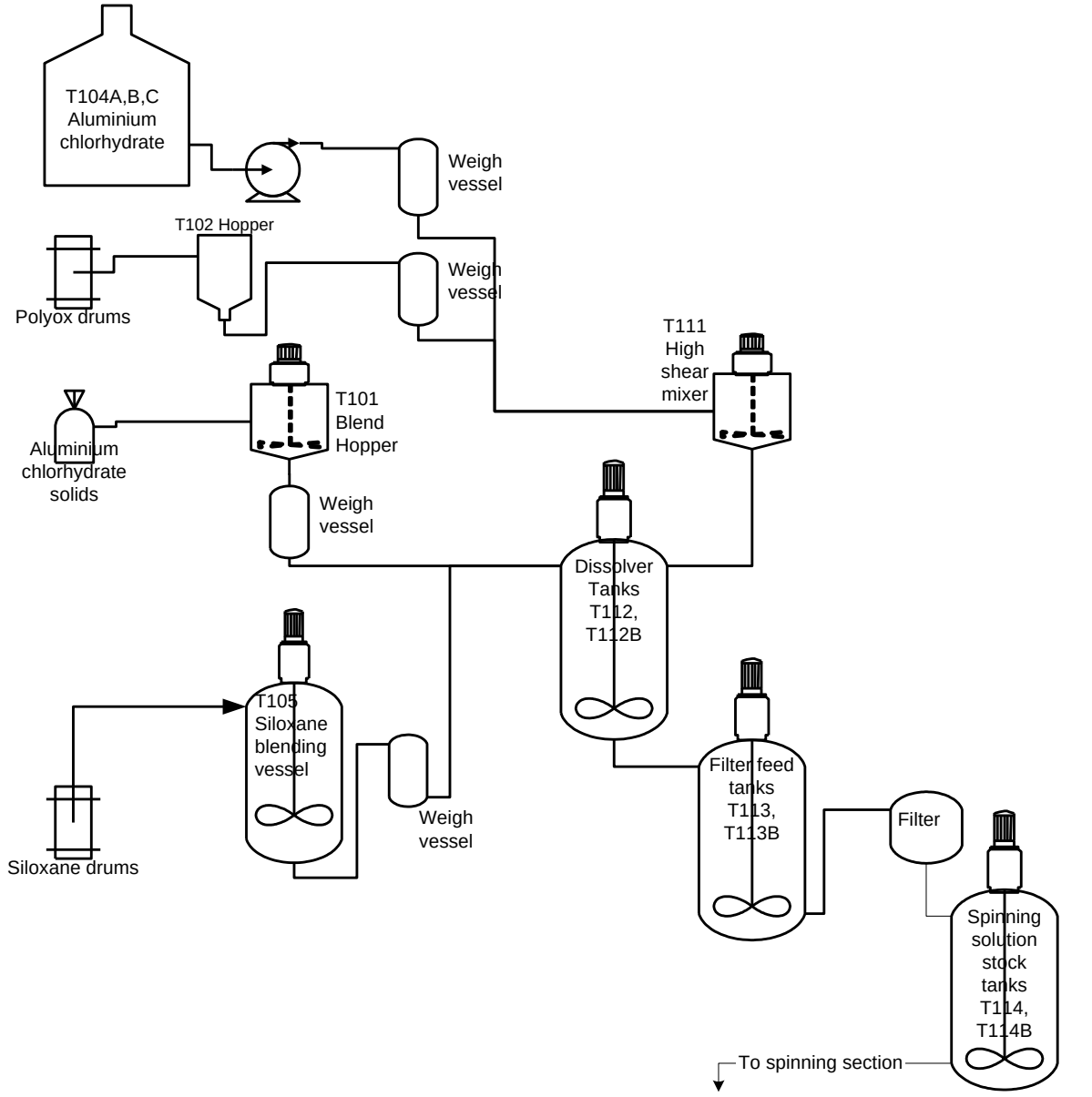


Figure 1 Saffil Solution Preparation Block Diagram

Manufacture of M-Fil solution is set out below (equipment shown in Figure 2). Additional connections to the dissolver are included for silica solution and polyethylene oxide addition to facilitate the production of M-Fil solution.

- Aluminium chlorohydrate solution is pumped from tanks T104A, B and C to dissolver T112C.
- Charge silica solution from silica solution reflux tank T151B to dissolver T112C.
- Charge polyethylene oxide from weigh vessel to dissolver T112C.
- Charge aluminium chlorohydrate solid from weigh vessel to dissolver T112C.
- Stir in dissolver T112C for a number of hours. Reduce stirring speed and add some Saffil solution from solution filter feed tank T114A into T112C.
- Continue stirring and sample for viscosity. Once target viscosity is reached release solution to filter feed tank T113C.
- Filter and feed forward through solution stock tanks to desired production line.

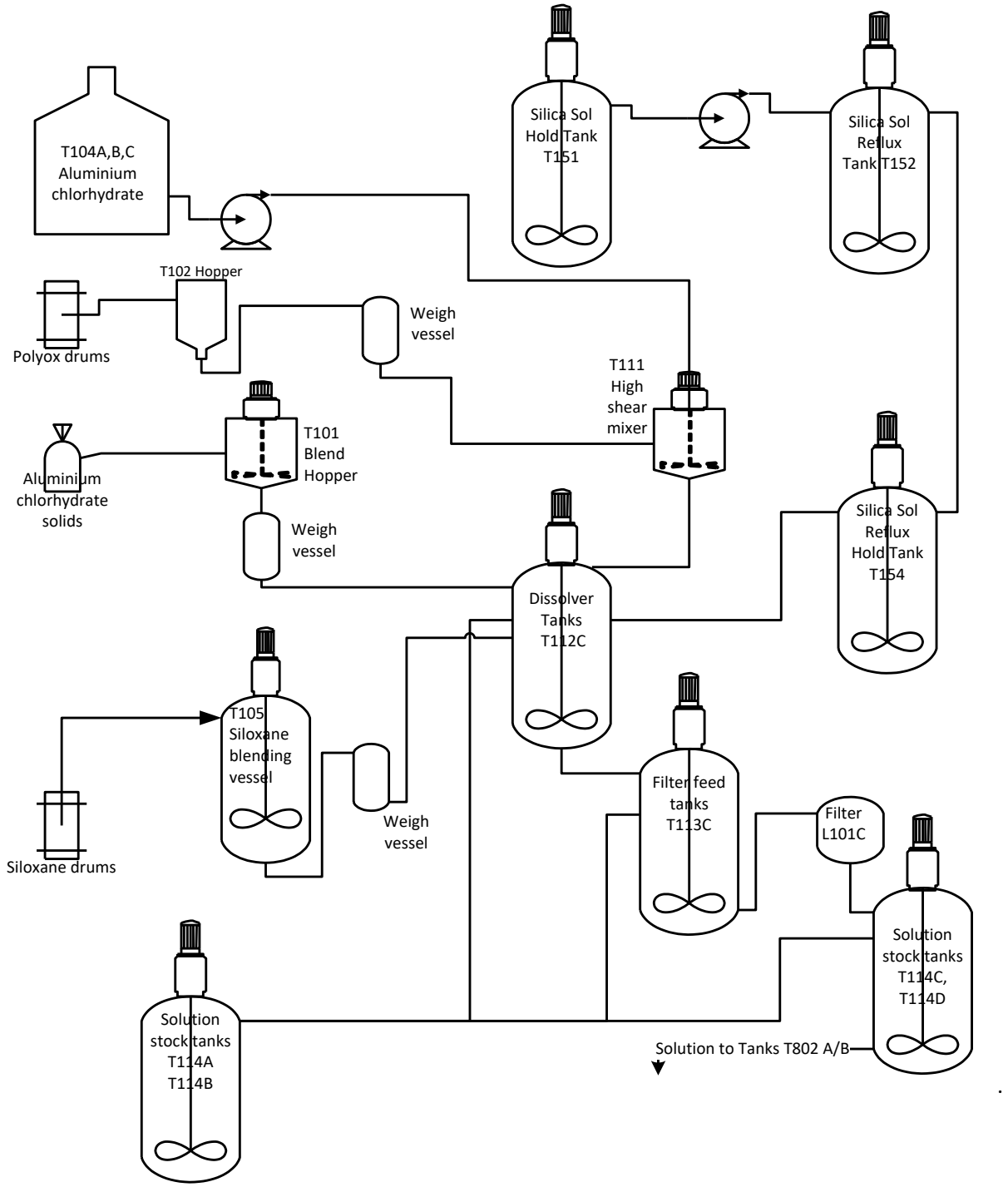


Figure 2 MFil Solution Preparation Block Diagram

Saffil solution (known as 'high rate' Saffil solution) can also be made using a process similar to M-Fil (equipment shown in Figure 3).

- Aluminium chlorohydrate solution is pumped from tanks T104A/B/C to T153 high shear dispersion tank.
- Add silcolapse and polyethylene oxide.
- Mix at prescribed speed for prescribed duration.
- Transfer to dissolver T112A/B/C.

- Add aluminium chlorohydrate solid to dissolver and stir for a number of hours. Check viscosity and add additional aluminium chlorohydrate solid to adjust to desired viscosity and stir. Add siloxane from T105 to the dissolver. Complete mixing cycle with additional stirring.
- Continue stirring and sample for viscosity. Once target viscosity is reached release solution to filter feed tank T113A/B/C.
- Filter and feed forward through solution stock tanks to desired production line.

Generally the solution preparation tanks are aligned to each production line although pipework is in place to feed the production lines from other solution preparation tanks should the need arise. The high shear mixer is common to all lines. All tanks are served by a dual pumping set (one on, one on standby).

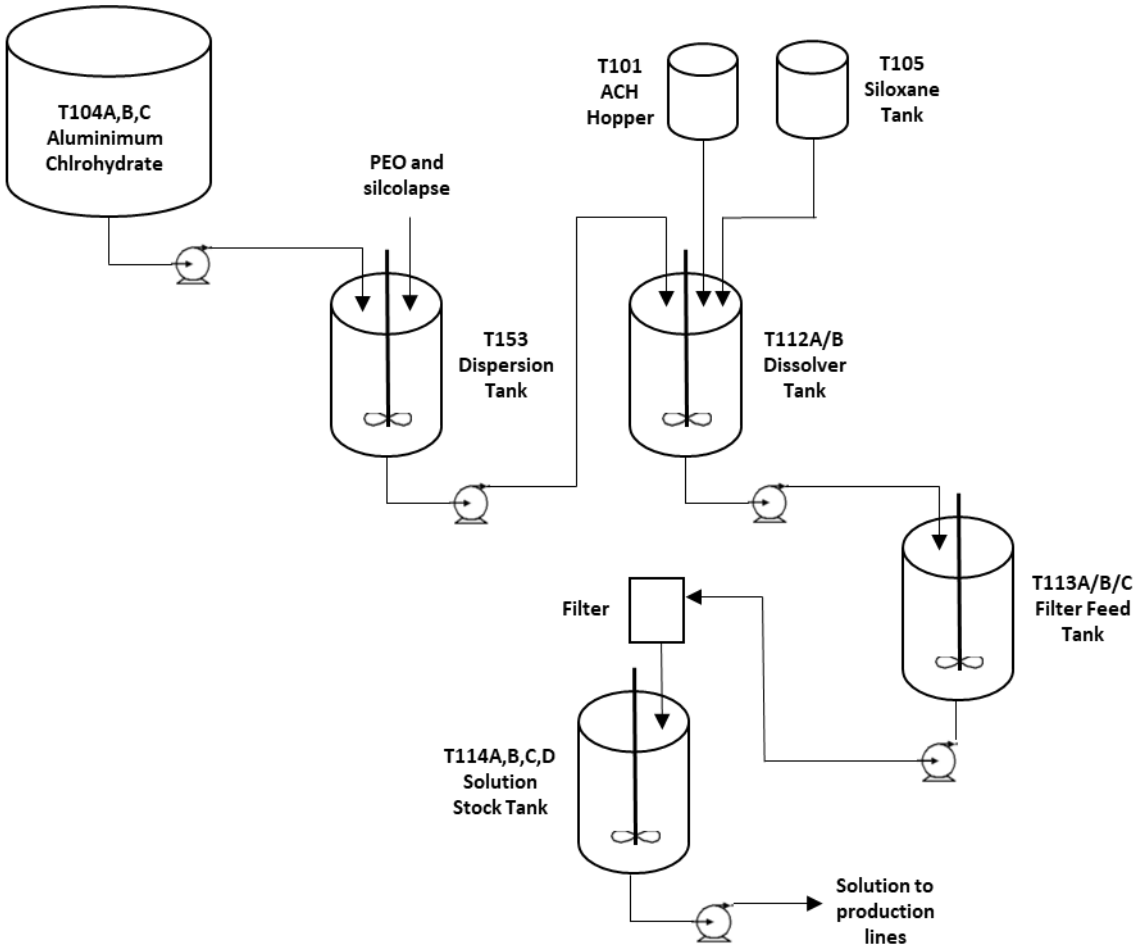


Figure 3 'High Rate' Saffil Solution Preparation Block Diagram

Line 4 solution preparation will be set up for silica fibre manufacture, although it will be possible to feed solution from the existing solution preparation processes to Line 4 for the manufacture of Saffil and M-Fil fibre. A new solution preparation building will be erected on the redundant Line 1 external slab (approximate dimensions 12 x 25 m – two storeys), which will contain the tanks below (other than the silica solution reception tanks which will be sited externally).

It is possible, to be confirmed during detailed design, that an additional dissolver T112D with associated pumps and pipework will be installed within the existing solution preparation building to service Saffil/M-Fil fibre manufacture on Line 4. This is included in the equipment list for Line 4 at the end of this section.

Table 5 Raw Materials Tanks

Tank	Concentration (%w/w)	Capacity (te)	Notes
Silica sol reception tanks (x 3)	Max 40%	60 each	Supplied by tanker
Silica sol reflux	Max 40%	30	Supplied from reception tank
Silica sol bulk storage	Max 40%	50	Storage prior to addition into solution preparation
Siloxane bulk storage	Blended siloxanes (25% silica)	10	
Mixing tank	variable	16	Supplied by tanker
Filter Feed Tank	variable	12	Finished solution prior to filtration
Filter			
Spinning solution	variable	12	Finished Solution for fibre manufacture spinning
Solution feed		2	For feed to spinning

The solution preparation steps for the manufacture of silica fibre are as follows (as shown in Figure 4):

- Add silica solution to reflux tank from reception tanks
- Reflux silica solution to pre-determined temperature and time
- Add refluxed silica solution to mixing tank from holding tank
- Add polyethylene oxide to mixing tank from the hopper
- Add siloxane to mixing tank from storage
- Stir the solution for pre-determined period until desired mixing and solution characteristics are achieved.
- Pump forward to the filter feed tank
- Pump through a filter to the spinning solution tank
- Transfer the solution from the spinning solution tank to the solution feed tank on Line 4

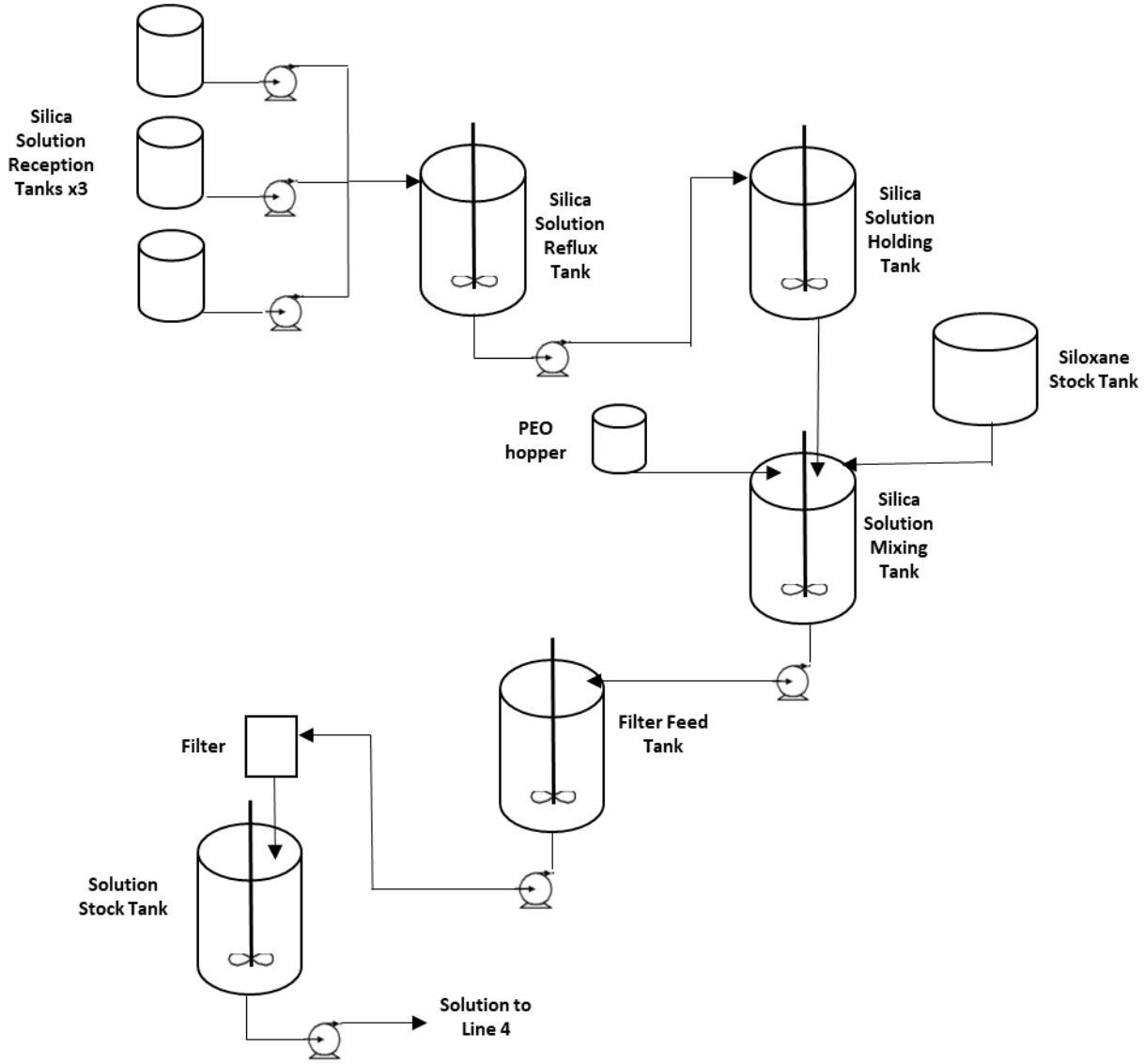


Figure 4 – Silica Fibre Solution Preparation Process

6.3 Spinning section

Solution is pumped to spinning from the solution feed tank through a heat exchanger to control the solution temperature. The process used is the same to make all fibre, although process settings vary depending on the type and/or grade of fibre in production.

The solution is made into fibre in a set of spinning chambers on Line 4 – the intention is to make a small increase in installed capacity (approx. 10-15%) for Saffil and M-Fil grades on Line 4 when compared with Line 3.

The solution is extruded as a fibre using primary air into a stream of warm air (secondary air) to dry and prevent the fibres from coalescing. The fibres are collected by filtering through a porous belt in the spinning chambers to form a mat. The mixed primary and secondary air is recycled through a heater into the secondary air recirculation and some of the mixed air is ejected to abatement (to remove fibre and HCl) prior to release from the stack.

Primary air is taken in from atmosphere and conditioned by heating and the use of a humidifier prior to introduction to the spinning chambers.

The spinning chambers on Line 4 will be split into groups of three to allow improved control. This will increase the amount of equipment associated with spinning.

There will be one primary air fan for the whole of spinning as Line 3, but Line 4 will differ on secondary air supply having a single secondary air fan plus associated heat exchangers/humidifiers per group of three spinning chambers. The flowrates of primary and secondary air per chamber will be the same as Lines 2 and 3. A review of waste heat recovery from the furnace to heat these air streams will be completed as part of the process design for Line 4.

The fibre that is made in the spinning process requires heat treatment to ensure the required chemical and crystalline properties of the finished product fibre are achieved.

6.4 Primary air

The Primary Air system comprises a fan followed by a water/steam fed humidifier. The system has pressure and temperature control instrumentation. The Line 4 Primary Air fan motor is a 415V variable speed drive; this is selected to minimise energy consumption.

6.5 Secondary air

The secondary air system to Line 4 spinning chambers is made up of a secondary air recirculation systems serving each group of three spinning chambers.

The Secondary Air system comprises a fan, bleed control valve, steam fed heater, spinning chambers with filters and recirculation ducting. The system has pressure and temperature control instrumentation. The secondary air purge passes to the scrubber to control chamber pressures and to remove hydrochloric acid gas.

The motors for the Line 4 Secondary Air fans and Primary Air fan will be 415V variable speed drive to minimise energy consumption and improve process control.

6.6 Heat train

Once the fibre is laid down in each spinning chamber and accumulated together on a single collection belt as a layered mat, the next stage is heat treatment. The stages are detailed below:

- Preheater Oven (Indirect Gas Fired) – Mesh belt oven operating at temperatures of typically 165-195^{o}C. Dries the fibre and removes a small amount of hydrochloric acid gas. Fume extraction hoods at inlet and outlet to take emissions to scrubber.
- Steaming Oven (Indirect Gas Fired) – Mesh belt oven with temperature profile 200^{o}C to 650^{o}C and addition of superheated steam. Produces amorphous fibre and removes impurities as volatile organic compounds (VOCs), hydrochloric acid gas and carbon oxides to thermal oxidation and scrubber.

- Low Temperature (LT) Furnace (Indirect Gas Fired) – Mesh belt oven with temperature profile from 550-1000°C. Produces desired fibre crystalline form – for silica and some Saffil fibre. Transitional crystallisation for other Saffil and M-Fil fibres. Includes cooling section at the end of the kiln to ensure fibre is cooled down prior to downstream handling processes.
- High Temperature (HT) Furnace (electrically fired or direct gas fired) (Saffil/M-Fil only) – Walking beam furnace to 1400°C. To ensure the correct crystalline form of alumina is achieved in Saffil and M-Fil fibres. Includes cooling section at the end of the kiln to ensure fibre is cooled down prior to downstream handling processes.

The gases from the steaming oven and LT furnace vents contain VOC and other organic compounds (e.g. carbon oxides, methane, trace dioxin) and hydrochloric acid and are treated in the thermal oxidiser and scrubbing system.

Air from the extract hoods on the first three stages of heat treatment, together with the preheater vents pass to the scrubber systems because the concentration of organics is very low in these streams.

Air from the HT furnace extraction hoods is treated in a dust extraction unit for the removal of particulates.

6.7 Product handling

The following facilities will be installed for silica fibre production:

- Picking unit – to remove, partially shred and transfer the fibre from the line to the milling section.

The milling section will be contained in a separate building and consists of:

- Pre Milling Unit – preparation of the fibre for introduction into milling.
- Milling – Use of a jet milling process to produce fibre particles to the required specification. Two milling machines will be installed – one on duty the other standby.
- Air compressor equipment – feed jet milling equipment
- Bulk bagging/baling

All these operations will be supplied with extensive dust extraction and capture equipment to ensure personnel are protected in line with regulatory hygiene standards and that emissions standards are in line with regulatory requirements.

A reeling machine will also be installed at the end of the line to make a reeled Saffil/M-Fil product. This is a machine to take the fibre mat as it comes forward and make a roll of fibre of controlled diameter and width interleaved with paper according to customer requirements. The reeling machine will have dust extraction hoods to remove dust caused during cutting and slitting which will be treated in a dust extraction unit for removal of particulates.

A baler machine for M-Fil and Saffil fibres will also be installed. This unit will shred and compression bale and bag the fibre, in a similar way to the process already in place on Line 1. Dust caused during compression and bagging operations will be treated in a dust extraction unit for removal of particulates.

7 Plant and production equipment

The following table lists major equipment to be retained relating to Line 1. Equipment to be formally removed from service in this variation is struck through.

Table 5 Line 1 Equipment

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
T111 High shear mixer	5m^3	316SS	Aluminium chlorohydrate solution and Polyethylene oxide	High level interlock. Overflow to bunded area.
T112A Dissolver Tank	10m^3	GRP	Aluminium chlorohydrate solution and solid and Polyethylene oxide and Siloxanes	Overflow to bunded area. High level Alarm and interlock
T113A Filter Feed Tank	10m^3	GRP	Aluminium chlorohydrate solution and solid and Polyethylene oxide and Siloxanes	Overflow to bunded area. High level Alarm High/High alarm/trip shutting off feed
T114A Spinning Solution Tank	12m^3	GRP	Aluminium chlorohydrate solution and solid and Polyethylene oxide and Siloxanes	Overflow to bunded area High level Alarm High/High level alarm & trip to feed pump to it
~~C201 Humidifier~~	~~Sump capacity 5.3m^3~~	~~304SS~~	~~Air/water/steam condensate~~	~~Overflow to drain High level alarm~~
~~F201 Primary Air Fan~~	~~28500m^3/h~~	~~Mild steel – coated~~	~~Air~~	~~None~~
~~E201 Primary Air Heater~~	~~24kW[electrically heated] 33,800kg/h~~	~~304SS~~	~~Air~~	~~None~~
~~F202 Secondary Air Fan~~	~~198000m^3/h~~	~~Mild steel – epoxy resin painted~~	~~Air [contains ~10mg/Nm^3 HCl]~~	~~None~~

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
~~E203 Secondary Air Heater~~	~~Steam heated~~	~~Copper tubes/MS shell~~	~~Air~~	~~Manual isolation~~
~~T302 Sodium hydroxide Stock Tank~~	~~36.5m^3~~	~~Carbon Steel~~	~~25% sodium hydroxide Solution~~	~~High level trip High level alarm Overflow to bunded area Vessel bunded 30% of vessel capacity Break away couplings~~
~~S201A – S201H (8vessels) Spinning Chambers~~	~~630Te/a Saffil product total~~	~~304SS~~	~~Saffil solution/fibre~~	~~None~~
~~X310 Pre Heating Oven~~	~~630Te/a Saffil product~~	~~321SS~~	~~Raw Saffil fibre~~	~~There are belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up.~~
~~X330 Steaming Oven~~	~~630Te/a Saffil product~~	~~Inconel/ 316SS~~	~~Raw Saffil fibre~~	~~There is belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up.~~
~~X340 Low Temperature Furnace~~	~~630Te/a Saffil product~~	~~Carbon steel/ Firebrick~~	~~Saffil fibre~~	~~There are belt speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up.~~

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
~~X350 High Temperature Furnace~~	~~630Te/a Saffil product~~	~~Carbon steel/Insulating fibre~~	~~Saffil fibre~~	~~Walking beam speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up.~~
Product Handling (Reeling machine and fibre shredder/baler)	N/A	Carbon Steel	Saffil/MFil/silica fibre	Dust extraction system. Water based filter on shredder.
~~C302 Single stage Scrubber column~~	~~Vol=4m^3, Working volume~~	~~GRP~~	~~Air containing HCl, dilute acidic aqueous solution~~	~~High temperature Trip shuts off steam to superheater (for decomposition oven) and vent fan. Overflow Level control and high level alarm. Low circulation flow trip shuts off steam to superheater (for decomposition oven) and vent fan.~~
~~F301 Vent Fan~~	~~53000m^3/h~~	~~Rubber lined carbon steel~~	~~Air vents containing < consent concentrations of contaminants except HCl.~~	~~Motor trip alarm shuts off steam to superheater (for decomposition oven).~~

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
~~C301 Vent Stack~~	~~28m high~~	~~GRP~~	~~Air vents containing < consent concentrations of contaminants~~	~~None~~
Shredder Dust filtration (Aquamat)	10000 m^3/hr	Resin lined mild steel	Air containing dust from shredder.	Local level indicator. Water level control. Trip failure alarm on fan.
Extraction fan and screen fibre removal	60000 m^3/hr	Mild steel	Air containing dust	Fan failure indicator in control room

The following table lists major equipment for Line 2, which is unchanged by this permit variation application.

Table 6 Line 2 Equipment (unchanged by this variation application)

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
T111 High shear mixer	5m^3	316SS	Aluminium chlorohydrate solution and Polyethylene oxide	High level interlock. Overflow to bunded area.
T112B Dissolver Tank	10m^3	GRP	Aluminium chlorohydrate solution and solid and Polyethylene oxide and Siloxanes	Overflow to bunded area. High level Alarm and interlock
T113B Filter Feed Tank	10m^3	GRP	Aluminium chlorohydrate solution and solid and Polyethylene oxide and Siloxanes	Overflow to bunded area. High level Alarm High/High alarm/trip shutting off feed

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
T114B Spinning Solution Tank	12m^3	GRP	Aluminium chlorohydrate solution and solid and Polyethylene oxide and Siloxanes	Overflow to bunded area High level Alarm High/High level alarm & trip to feed pump to it
C601 Humidifier	Sump capacity 5.3m^3	304SS	Air/water/steam condensate	Overflow to drain High level alarm
F601 Primary Air Fan	28500m^3/h	Mild steel - coated	Air	None
E601 Primary Air Heater	24kW[electrically heated] 33,800kg/h	304SS	Air	High temperature opens vent valve to secondary air system.
F602 Secondary Air Fan	198000m^3/h	Mild steel – epoxy resin painted	Air [contains ~10mg/Nm3 HCl]	None
E603 Secondary Air Heater	Steam heated	Copper tubes/MS shell	Air	Manual isolation
T702 Caustic Stock Tank	36.5m^3	Carbon Steel	25% Caustic Soda Solution	High level trip High level alarm Overflow to bunded area Vessel bunded 110% of vessel capacity, Break-away couplings
S601A – S601H Spinning Chambers	1000 Te/yr	304SS	Saffil solution/fibre	High pressure shuts off F601
X710 Pre Heating Oven	1000 Te/yr	Mild Steel	Saffil fibre	There is Belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
X730 Steaming Oven	1000 Te/yr	Inconel/mild steel	Saffil fibre	There is Belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up.
X740 Low Temperature Furnace	1000 Te/yr	Carbon steel/ Firebrick	Saffil fibre	There is Belt speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up.
X750 High Temperature Furnace	1000 Te/yr	Carbon steel/Insulating fibre	Saffil fibre	Walking beam speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up.
Product Handling	1000 Te/yr	Mild steel	Saffil fibre	Dust extraction system
L770A – C Filters	2600 kg/hr	Hastelloy	Air/steam plus HCl, VOCs, Dioxins, Dust	PLC controls, alarms and trips system.
C771 Quench column	2600 kg/hr	Hastelloy/Rubber lined mild steel	Air/steam plus HCl, VOCs, Dioxins	PLC controls, alarms and trips system
X773 Thermal Oxidiser plus regenerators	1300 kg/hr	Steel/ refractory	Air/steam plus HCl, VOCs, Dioxins	Temperature alarms/trips PLC monitoring of operation
F773 Oxidiser fan	1300 kg/hr	Hastelloy	Air containing HCl	PLC monitoring of operation. Variable speed drive.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
C774/775 2-stage Scrubber column	Working volume= 12 Te	GRP	Air containing HCl, dilute acidic aqueous solution	PLC controls, alarms and trips system. Overflows on each stage.
F776 Vent Fan	53000 kg/hr	Rubber lined carbon steel	Air vents containing < consent concentrations of contaminants	PLC monitoring of operation. Variable speed drive.
C776 Vent Stack	40m high	GRP galvanised carbon steel external frame	Air vents containing < consent concentrations of contaminants	None
Dust filtration system (Cyclone and bag filters)	60000 m3/hr	Mild steel	Air containing dust	PLC monitoring of operation.

The following table lists major equipment for Line 3, which is unchanged by this permit application.

Table 7 Line 3 Equipment (unchanged by this permit application)

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
T153 High Shear Dispersion Tank	5m^3	Stainless steel	Aluminium chlorohydrate and Polyox	Overflow to bunded area. High level Alarm and interlock
T112C Dissolver Tank	10m^3	GRP	Aluminium chlorohydrate solution and solid and Polyox and Siloxanes	Overflow to bunded area. High level Alarm and interlock
T113C Filter Feed Tank	12m^3	GRP	Aluminium chlorohydrate solution and solid and Polyox and Siloxanes	Overflow to bunded area. High level Alarm High/High alarm/trip shutting off feed
T114C Spinning Solution Tank	15m^3	GRP	Saffil or M-Fil spinning solution	Overflow to bunded area High level Alarm High/High level alarm & trip to feed pump to it

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
T114D Spinning Solution Tank	15m^3	GRP	Saffil or M-Fil spinning solution	Overflow to bunded area High level Alarm High/High level alarm & trip to feed pump to it
T151 Silicasol Storage Vessel	35m^3	GRP	Silica sol	Overflow to bunded area High level Alarm High/High level alarm & trip to feed pump to it
T152 Silicasol Reflux Vessel	5m^3	Stainless Steel	Silica sol	Overflow to bunded area High level Alarm High/High level alarm & trip to feed pump to it
T154 Silicasol Reflux Hold Vessel	10m^3	Stainless Steel	Silica sol	Overflow to bunded area High level Alarm High/High level alarm
C801 Humidifier	Sump capacity 5.3m^3	304SS	Air/water/steam condensate	Overflow to drain High level alarm
F801 Primary Air Fan	28500m^3/hr	Mild steel - coated	Air	None
E801 Primary Air Heater	Steam heated	Cupro nickel tubes/MS shell	Air	High temperature opens vent valve to secondary air system.
F802 Secondary Air Fan	198000m3/hr	Mild steel – epoxy resin painted	Air (trace HCl)	None
E803 Secondary Air Heater	Steam heated	Cupro nickel tubes/MS shell	Air	Manual isolation
T1002 Caustic Stock Tank	36.5m3	Carbon Steel	25% Caustic Soda Solution	High level trip High level alarm Overflow to bunded area Vessel bunded 110% of vessel capacity, Break-away couplings

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
T802 A/B Solution Feed Tanks	3m3	GRP	Saffil or M-Fil spinning solution	High level trips feed pump. High level alarm Overflow to bunded area
S801A – S801H (8vessels) Spinning Chambers	1250 Te/yr	304SS	Saffil solution/fibre	High pressure shuts off F801/F802
X910 Pre Heating Oven	1250 Te/yr	Mild Steel	Saffil fibre	Belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up. Vents to abatement unit.
X930 Steaming Oven	1250 Te/yr Saffil product	Inconel/stainless steel	Saffil fibre	Belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up. Vents to abatement unit and dust extraction unit.
X940 Low Temperature Furnace	1250 Te/yr Saffil product	Carbon steel/refractory brick and tiles	Saffil fibre	Belt speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up. Connected to dust extraction unit.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
X950 High Temperature Furnace	1250 Te/yr Saffil product	Carbon steel/Insulating fibre and refractory sections	Saffil fibre	Walking beam speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up. Connected to dust extraction unit.
Product Handling	1250 Te/yr Saffil product	Mild/stainless steel	Saffil fibre	Connected to dust extraction unit.
L970 Hot Gas Filters	2600 kg/hr	Hastelloy with ceramic filter elements	Air/steam plus HCl, VOCs, Dioxins, Dust	Delta V controls, alarms and trips system connected to plant shutdown system.
C971 Quench column	2600 kg/hr	Hastelloy/Rubber lined mild steel	Air/steam plus HCl, VOCs, Dioxins	Delta V controls, alarms and trip system connected to plant shutdown system.
X973 Regenerative Thermal Oxidiser	1300 kg/hr	Steel/ refractory	Air/steam plus HCl, VOCs, Dioxins	Alarms/trips connected to plant shutdown systems. Delta V monitoring of operation
F973 Oxidiser fan	1300 kg/hr	Hastelloy	Air containing HCl	Alarms/trips connected to plant shutdown systems. Delta V monitoring of operation. Variable speed drive controls.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
C974 Scrubbing equipment		GRP	Air containing HCl and VOC, dilute acidic aqueous solution	Delta V controls, alarms and trips connected to plant shutdown systems. Overflows to bund.
F976 Vent Fan	53000 kg/hr	Rubber lined carbon steel	Air vents containing < consent concentrations of contaminants	Delta V monitoring of operation. Variable speed drive controls.
C976 Vent Stack	40m high	GRP galvanised carbon steel external frame	Air vents containing < consent concentrations of contaminants	None
Dust filtration system (Bag filters)	60000 m3/hr	Mild steel – epoxy coated with fabric bags	Air containing dust	Delta V monitoring of operation. Pressure measurement across system to inform re: blockages.

The following table lists major equipment for Line 4.

Table 8 Line 4 Equipment

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
Silica Solution Reception Tanks (x 3)	60 te	Stainless Steel	Max 40% Silica solution	Overflow to bunded area. High level Alarm and interlock
Silica Solution Reflux Tank	30 te	Stainless Steel	Max 40% Silica solution	Overflow to bunded area. High level Alarm and interlock
Silica Solution Bulk Holding Tank	50 te	Stainless Steel	30% Silica solution	Overflow to bunded area. High level Alarm and interlock

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
PEO Hopper	2 m^3	Stainless Steel	Polyethylene Oxide powder	Containment area in case of solid spillage
Siloxane Storage Tank	4 m^3	Steel	25% siloxane (blended from a number of drummed sources)	Overflow to bunded area. High level Alarm and interlock
T112D Dissolver Tank (Saffil/M-Fil spinning solution)	10m^3	GRP	Aluminium chlorohydrate solution and solid and Polyox and Siloxanes	Overflow to bunded area. High level Alarm and interlock
Mixing Tank (silica spinning solution)	16m^3	GRP	Spinning solution (in process)	Overflow to bunded area. High level Alarm and interlock
Filter Feed Tank (silica spinning solution)	12m^3	GRP	Finished spinning solution (unfiltered)	Overflow to bunded area. High level Alarm and interlock
Spinning Solution Filter (silica spinning solution)	To be confirmed during detailed design	Steel	Finished spinning solution	Overflow to bunded area. High level Alarm and interlock
Spinning Solution Tank (silica spinning solution)	12m^3	GRP	Finished spinning solution	Overflow to bunded area. High level Alarm and interlock
Primary Air Humidifier	Sump capacity 5.3m^3	304SS	Air/water/steam condensate	Overflow to drain High level alarm
Primary Air Fan	32500 m^3/hr	Mild steel - coated	Air	None
Primary Air Heater	Steam heated	Cupro nickel tubes/MS shell	Air	High temperature opens vent valve to secondary air system.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
Secondary Air Fans	75000 m^3/hr each	Mild steel – epoxy resin painted	Air (trace HCl)	None
Secondary Air Heaters	Steam heated (approx. 0.3 MW each)	Cupro nickel tubes/MS shell	Air	Manual isolation
Caustic Stock Tank	36.5m^3	Carbon Steel	25% Caustic Soda Solution	High level trip High level alarm Overflow to bunded area Vessel bunded 110% of vessel capacity, Break-away couplings
Solution Feed Tanks (x2)	3m^3	GRP	Saffil/M-Fil/Silica spinning solution	High level trips feed pump. High level alarm Overflow to bunded area
Spinning Chambers	Capable of silica and Saffil/M-Fil	304SS	Saffil/M-Fil/Silica solution/fibre	High pressure shuts off primary and secondary air fans
Pre Heating Oven	Capable of silica and Saffil/M-Fil	Mild Steel	Saffil/M-Fil/Silica fibre	Belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up. Vents to abatement unit.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
Steaming Oven	Capable of silica and Saffil/M-Fil	Inconel/stainless steel	Saffil/M-Fil/Silica fibre	Electric fired. Combined heat treatment unit with provision for superheated steam addition Belt speed control, temperature control and trips Solid spillage to concrete floor – spillage swept up. Vents to abatement unit and dust extraction unit.
Low Temperature Furnace	Capable of silica and Saffil/M-Fil	Carbon steel/refractory brick and tiles	Saffil/M-Fil/Silica fibre	Gas fired. Belt speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up. Vents to abatement and dust extraction unit.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
High Temperature Furnace	For Saffil/M-Fil production – not needed for silica	Carbon steel/Insulating fibre and refractory sections	Saffil/M-Fil fibre	Walking beam speed control, temperature control and alarms. Solid spillage to concrete floor – spillage swept up. Connected to dust extraction unit.
Product Handling – reeling machine		Mild/stainless steel	Saffil/M-Fil fibre	Connected to dust extraction unit.
Product Handling – In line picker and conveyor		Specialist steels Breaks up and transfers silica fibre from the line to chopping	Silica fibre	Connected to dust extraction unit
Product Handling – chopping machine		Stainless steel Pre-chops fibre before milling	Silica fibre	Connected to dedicated dust extraction unit.
Product Handling – jet milling machines (x2)		Stainless steel	Silica fibre	Connected to dedicated dust extraction unit.
Product Handling – Big bag filling		Steel	Silica fibre	Connected to dedicated dust extraction unit.
Product Handling – shredder and fibre compression baler		Steel	Saffil/M-Fil fibre	Connected to dust extraction unit.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
Hot Gas Filters	Similar to Line 3	Hastelloy with ceramic filter elements	Air/steam plus HCl, VOCs, Dioxins, Dust	Delta V controls, alarms and trips system connected to plant shutdown system.
Quench column	Similar to Line 3	Hastelloy/Rubber lined mild steel	Air/steam plus HCl, VOCs, Dioxins	Delta V controls, alarms and trip system connected to plant shutdown system.
Regenerative Thermal Oxidiser	Similar to Line 3	Steel/ refractory	Air/steam plus HCl, VOCs, Dioxins	Alarms/trips connected to plant shutdown systems. Delta V monitoring of operation
Oxidiser fan	Similar to Line 3	Hastelloy	Air containing HCl	Alarms/trips connected to plant shutdown systems. Delta V monitoring of operation. Variable speed drive controls.
Scrubbing equipment	Similar to Line 3 – additional secondary air from additional chambers	GRP	Air containing HCl and VOC, dilute acidic aqueous solution	Delta V controls, alarms and trips connected to plant shutdown systems. Overflows to bund.

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
Vent Fan	Similar to Line 3 – additional secondary air from additional chambers	Rubber lined carbon steel	Air vents containing < consent concentrations of contaminants	Delta V monitoring of operation. Variable speed drive controls.
Vent Stack	40m high	GRP galvanised carbon steel external frame	Air vents containing < consent concentrations of contaminants	None
Dust filtration system (Bag filters) Dust extraction from the production line for all fibres	60000 m^3/hr	Mild steel – epoxy coated with fabric bags	Air containing dust	Delta V monitoring of operation. Pressure measurement across system to inform re: blockages.

The following table lists major equipment for the boilers.

Table 9 Boiler Equipment

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
EXISTING: Diesel Tank	10,000 litres	Carbon steel	Diesel	High level alarm, self bunded (double-skinned)
EXISTING: Boiler fired on gas fitted with vent gas economiser	12 te/hr steam	Carbon steel	Steam to 10 barg/hot water	Pressure relief system Burner management system Gas cut off valve High, low and low low level trips Water dosing

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
EXISTING: Boiler fired on gas fitted with vent gas economiser; This boiler can also be fired on diesel if there is a gas supply interruption	12 te/hr steam	Carbon steel	Steam to 10 barg/hot water	Pressure relief system Burner management system Gas and oil cut off valves High, low and low low level trips Water dosing
NEW: Boiler fired on gas fitted with vent gas economiser; This boiler can also be fired on diesel if there is a gas supply interruption	12 te/hr steam	Carbon steel	Steam to 10 barg/hot water	Pressure relief system Burner management system Gas and oil cut off valves High, low and low low level trips Water dosing

Equipment Item	Nominal Capacity	Materials of Construction	Material(s) processed/ stored	Protective Systems
~~Oil fired standby boiler~~	~~6 te/hr steam~~	~~Carbon steel~~	~~Steam to 10 barg/hot water~~	~~Pressure relief system~~ ~~Burner management system. Oil cut off valves~~ ~~High, low and low low level trips~~ ~~Water dosing~~
EXISTING: Hotwell (possible size upgrade-detailed design)	20 m^3	Stainless steel	Treated boiler feed water to 85 deg C	Level control Overflow and vent
EXISTING: Raw water tank (possible size upgrade-detailed design)	5 m^3	Plastic	Mains water	Level control Overflow and vent
EXISTING: Blowdown vessel (possible size upgrade-detailed design)	2 m^3	Carbon steel	Hot water blowdown	Cold water sparge Overflow and vent
EXISTING: Diesel tank – forklift truck fuel fill	1 m^3	Carbon steel	Diesel	Double skinned
EXISTING: Diesel tank – fire suppression	3 m^3	Carbon steel	Diesel	Double skinned

8 Plant services

8.1 Steam

8.2 Steam production boilers

The steam production facilities include:

- Boiler 1; fired only on natural gas.
- Boiler 2; fired on natural gas; or in the event of gas supply interruption, fired on diesel.
- NEW: Boiler 3; fired only on natural gas; or in the event of gas supply interruption, fired on diesel.

There are currently two natural gas fired boilers in use on the site raising saturated steam at 8 barg pressure. One of these is also operable on diesel, to be used should there be an interruption to the gas supply. An older diesel fired boiler has been removed from service and will be formally taken out of service by this variation.

The Line 4 project will require the addition of a third new dual fuel natural gas/diesel boiler to increase the steam raising capacity on the site.

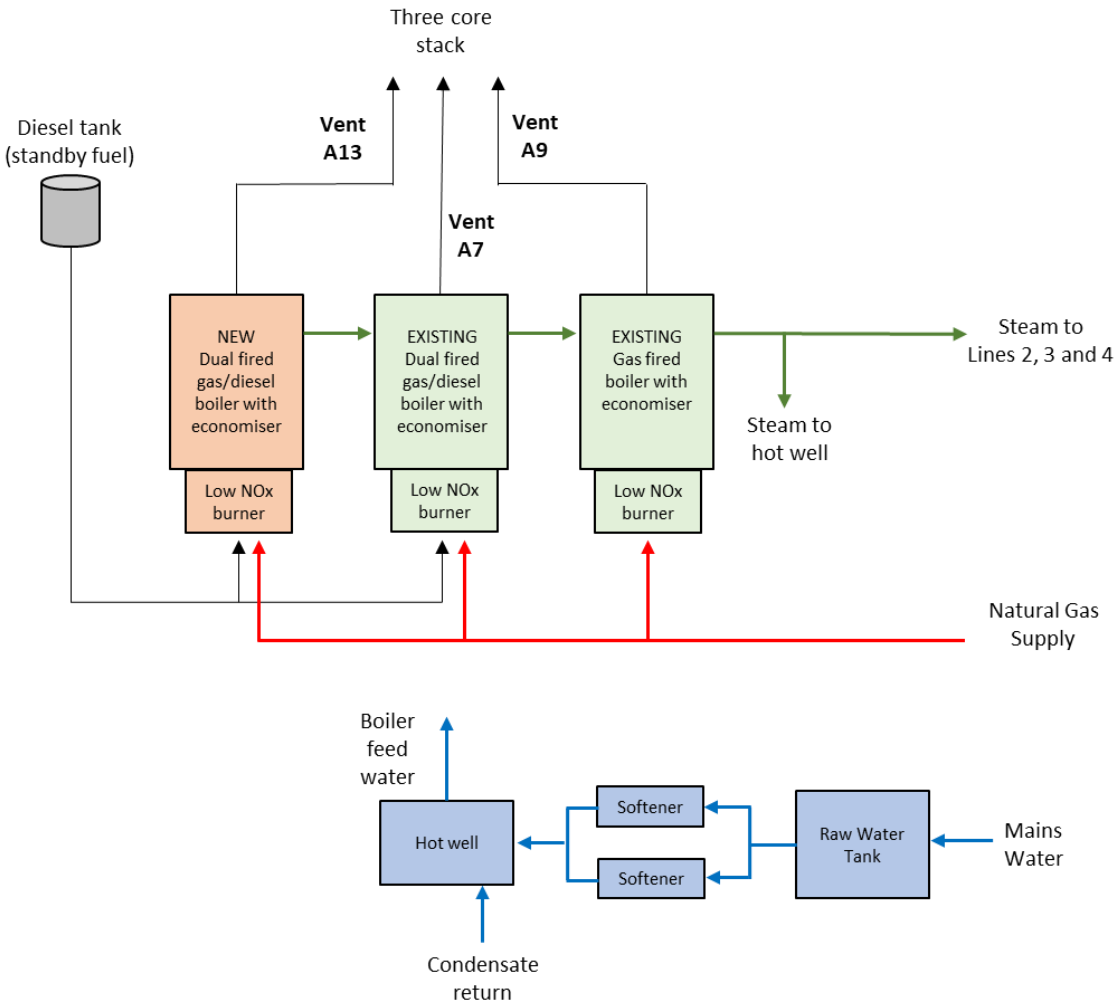
The site boiler capability is summarised in the table below.

Total steam demand for all three lines is about 15 te/hour. This can be supplied by firing gas in two of the three boilers at below full steam rate, with the third on hot standby. Duty and standby boilers are switched to ensure approximately equal running hours on each boiler.

The use of three boilers enables fibre production to continue during statutory boiler inspections and gas supply interruptions.

Table 10 Boiler loads

Fuel	Maximum Load (Te/hr)	Purpose
Gas	12	Existing
Gas/Diesel	12	Existing
Gas/Diesel	12	New



Blowdown water from the boilers is cooled and sent to industrial sewer (stream S4).

8.3 Handling and storage of materials

8.3.1 Feedstock and process chemicals

Diesel is currently stored in a steel tank self-bunded to 110% of maximum operating limit.

Usage is covered in document 009 – Raw Materials.

8.3.2 Process chemicals associated with utilities

Process chemicals are employed in the cooling water and boiler feed water dosing systems.

Usage is covered in document 009 – Raw Materials.

8.4 Instrument Air

Site plant and instrument air are currently supplied by two centrifugal, multi-staged, inter-cooled water-cooled compressors. These will be replaced and upgraded in capacity by improved efficiency air cooled air compressors with provision for duty and standby operation to ensure minimal supply interruption.

Additional stand-alone instrument air compressor capacity will be installed to support shredding and jet milling operations on Line 4.

The instrument air compressors are located in a compressor house with suitable facilities to avoid loss of oil to the drain.

Capacity of the compressors are to be confirmed in detailed design and in discussion with equipment suppliers.

8.5 Water supply

Mains water is supplied into a site break tank located near Line 2 and from there pumped via break tanks or directly to users on the site. There is a second break tank located at high level in the solution preparation building used to supply process water and emergency water to Lines 2 and 3.

New water supply infrastructure will be installed to serve Line 4. The existing mains feed to the site will remain unchanged.

There is also a direct mains feed to the boiler raw water tank which will be resized if necessary for the additional steam capacity needed to serve Line 4.

Water usage is covered in document 009 – Raw Materials.

8.6 Cooling water

The main uses of cooling water are to extract heat at the air compressors, high shear mixer, silica solution reflux unit and to provide other process cooling duties.

A new uprated cooling tower with associated dosing equipment will be fitted to serve the site. The principal increased cooling water usage will be associated with the Silica solution reflux process to feed Line 4 silica fibre production.

The drain and total dissolved solids (TDS) purge from the cooling tower is to stormwater drain W3 as previously.

Cooling water usage is covered in document 009 – Raw Materials.