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Dear Rick

Results of Odour Extraction system Inspection

This email summarises results from our inspection of the Rendering Plant air extraction system at the Imlay meat works on 4 May 2016.

1 Background and Objective

Previous inspection of the Imlay Rendering Plant air extraction system occurred on 16 March 2015. The objective of these inspections has been to independently check that the system is operating as it should be to meet air discharge Consent obligations.

Prior to the 2015 inspection a stickwater evaporator had been commissioned to use available waste heat from the drier exhaust gas stream. To aid performance of the evaporation plant the air flow to the covered biofilter was halved by insertion of an orifice plate upstream of fan ID2. This inspection report is the second one done under the reduced drier vapours air flow.

2 Assessment of Extraction System Performance

2.1 Figures and Tables

Figure 1 in Appendix A provides a schematic of the Dry Side, Wet side and Drier air extraction system feeding the biofilters.

Table 1 in Appendix A summarises the measured data for the Drier to Covered Biofilter in Fig 1.

Table 2 in Appendix A summarises measured data for the Wet Side to Uncovered Biofilter in Fig 1.

Table 3 in Appendix A provides an overview of measured data since 2008 for comparison.

2.2 System Description

With reference to Figure 1:

a) Dry Side gas passes through a spray tower (known as the Dry Process heat exchanger or Dry Process Humidifier in Fig 1) to a common induced draught fan (ID1) which discharges into the uncovered biofilter. The primary function of the spray tower is the humidification of the Dry Side gas flow that might otherwise dehydrate the biofilter and reduce biological activity.

b) Wet Side gas and vapour is cooled in the Wet Process heat exchangers; i.e. Wet Process HX1, HX2 and HX3. After cooling and some water removal, the Wet Side gas passes to the common ID1 fan which discharges into the uncovered biofilter.

c) Drier gas and vapour passes through the Drier Trash Vessel which removes entrained water and then to a newly installed stickwater waste heat evaporator. The cooled Drier gases and non-condensable gases from the evaporator vacuum pump then pass through two heat exchangers (Gardiner HX and Potter HX) which further cool the gas and vapour and remove condensed water from the gas stream. After cooling and water removal the Drier gas passes to induced draught fan ID2 which discharges to the covered biofilter. As pressure in the evaporator non-condensable gas discharge duct is to be -10 to -20mm wg an orifice plate OP has been inserted in the duct to moderate the vacuum.

d) Water in the Dry Process humidifier (previously called the Dry Process heat exchanger) is recirculated by a pump (P1) with water make up from the adjacent pond.

2.3 Process Measurements

The biofilter gas and vapour systems were characterised by: thermocouple readings and Pitot tube gas velocity readings taken by removing plugs and inserting instruments at:

- The outlet from the Drier gas fan, ID2.
- The gas ductwork inlet to the Dry Process humidifier.
- The gas outlet ductwork from Wet Process Heat Exchangers HX1, HX2 and HX3, prior to the connection with ductwork from the Dry Process humidifier and prior to the ID1 fan.
- The gas duct outlet ductwork from the ID1 fan static pressure measurements made at the covered biofilter distributor ducting end.
- Temperature and pH spot measurement of the biofilter media.
- Infiltration airflow into the wet processing area measured when the roller door was open.

2.4 Comments on Flowrates, Pressure and Temperatures

Table 1 shows the results of flowrate and temperature measurements taken during the day of 4 May 2016 which was characterised by warm temperatures and light north to north-west wind.

From the data in Figure 1 and Tables 1 and 2:

2.4.1 Covered Biofilter Airflow

The air flow to the covered biofilter was 2400 m^3/h or 2.9 tonnes/hour (tph). This was based on measurements taken over a 5 hour period at the thermowell six metres downstream of the ID2 fan. This was the only readily available access into the duct. The measured flow was 50% more than that measured last year but only 65 – 80% of the airflows that existed prior to insertion of the orifice plate (OP in Fig 1) into the line upstream of fan ID2. No biofilter performance issue had been seen to arise from the reduced airflow last year. The loading on the biofilter was reduced and the further cooling of drier air which occurred in the evaporator heat exchanger reduced any tendency for smoke to break out of the biofilter.

The 2015 report mentioned that the addition of the new orifice plate to limit drier gas vacuum in the evaporator would have an effect on the operating efficiency of fan ID2. It was suggested this could be improved by driving the fan at a lower speed with less orifice constriction. In the 2016 inspection the fan was still being driven as it had been yet the flowrate was significantly up.

On enquiry it was learned that the southern half of the covered biofilter media had been replaced as was recommended in the previous report. Hence the increased air flow could be partly explained by the reduced pressure drop in the biofilter bed and in particular the reduced pressure difference across fan ID2 which gives a different fan flow-pressure characteristic. Another possibility for the increased flow is that the orifice plate aperture might have eroded to a larger opening.

Overall no issues are seen to arise from the increased flow and the biofilter loading is still less than what it has been in the past.

2.4.2 Uncovered Biofilter Airflow

The air flow to the uncovered biofilter was 39,100 – 41,400 m^3/h or 44.3 – 46.6 tph and was based on measurements taken over a 5 hour period at a removable plug eight metres downstream of the ID1 fan. The measured flow is similar to that of the previous seven years. As seen in Figure 1 a total flow of around 47 tph was made up of 21 tph of Wet Side vapour and 26 tph of Dry Side Gas. The Wet Side vapour flow is similar to what it has been in the past as also was the Dry Side Gas. No change to the total airflow is needed nor any change in the airflow split between dry and wet side.

2.4.3 Covered Biofilter Media

The moisture content of the bark media in the covered biofilter at 100mm below the surface was found to be between 42 and 62% w/w (wet basis). This is a good result over the bed area. The air loading on the biofilter of 28 m^3/h of air per m^3 of media is within the recommended range for the type of air. No traces of smoke were observed at any time. An indicative test of media pH gave a result of 6.0 – 7.5. The temperatures in the bed at 200mm depth ranged from 18°C to 21°C. It is noted that the temperatures were consistently slightly higher in the southern half of the bed – this likely arises from higher flowates in the southern half of the bed arising from the replaced media. The pressure drop across the bed was found to have fallen from 8 mm wg at the last inspection to 6 mm wg. With reference to historic bed total pressure values in Fig 3, the low pressure can be explained by the media partial replacement and the reduced airflow arising from the insertion of the orifice plate between the evaporator and ID1 fan.

As was recommended in the previous report it is understood that the compacted clay mass in the southern half of the biofilter was dug out and replaced while the northern half was still working as a biofilter. It is also understood the distributor piping was found to be blocked with fat and replaced.

With the current bed loading and pressure drop there does not seem to be any need to replace the media in the northern half of the biofilter yet – it appears that the reduced air flow over what it once was and the extra cooling provided by the evaporator enables the biofilter to work satisfactorily.

Another recommendation in the previous report was that the mortar sealing of the manhole at the west end of the biofilter be repaired to stop leakage. It was noted that this had been done but has now drawn attention to what appears to be leakage between the manhole cover plate and the cast iron frame it sits in. It is understood the manhole cover is rarely removed hence a bead of sealant or a winding of cord packing around the cover skirt should stop this leakage. It was also noted that the distributor pipe to the biofilter also had some holes in it.

Suggested Action:

That the covered biofilter manhole and feed line to the distributors from fan ID2 be closely inspected for leaks and repaired to eliminate drier odour sensed in the vicinity.

2.4.4 Un-covered Biofilter Media

The moisture content measurements in the uncovered biofilter ranged from 31 to 38% moisture w/w wet basis which was too dry. Measurements were made near the end of a long spell of dry weather so the moisture content is likely to now be back within satisfactory range.

The temperatures measured in the bed ranged from 27°C to 30°C indicating acceptably uniform distribution. A bed permeability check was also made at the time of temperature measurement. There was evidence of upward gas flow in all parts of the biofilter. It was noted that around 100mm of the top of the biofilter bed is getting quite compacted but aged graded bark is found below that. It is possible that the top compacted layer is the legacy of earth having been temporarily dumped there rather than final degradation of the bark. The biofilter loading at 59 m^3/h of air per m^3 of media is within the recommended range for the type of air. The media pH was found to be 5.5 – 7.0 in an indicative test. This is satisfactory. The distributor and media pressure drop (as measured at the test point downstream of the fan) has again decreased slightly over the last year from 45 mm wg to 32 mm wg. Bed pressure drop at the five biofilter manometers ranged from 11 to 21mm wg. These have not worked well in the past and are of questionable reliability.

It is possible that the low pressure drop may be caused by channelling in the media although no evidence of that was found. The main discharge line consists of concrete pipe sections joined by rubber sleeves. Several holes were found at joints where the pipes are partially bedded in the ground downstream of the fan ID1 which could account for some of the lower pressure drop.

Current air flow through the bed is good and evenly distributed with the pressure drop in the distributors and the bed being much the same as what it was in 2008. The highest measured static pressure downstream of ID1 was 138 mm wg in 2011 but as recent maintenance has shown, tillage of the top part of the bed is still capable of keeping bed pressure drop near to what it was when the media was last renewed.

If it was desired to have the biofilter in top working order, all of the media would be removed and stored in piles according to its nature i.e. stone in one place, coarse bark in another and fine bark in another. From memory there is not much coarse bark in the uncovered biofilter, but with the finer bark removed the media near the distributor pipes can be easily loosened. The material along with new bark can then be returned to the biofilter. This work is labour intensive and good practice but may not give a noticeable difference.

The media is surprisingly currently still in satisfactory working condition apart from a need for tillage of the top of the bed.

Action:

(a) It is recommended that the top of the uncovered biofilter bed be tilled to reduce the likelihood of channelling.

(b) The distribution line downstream of the ID1 fan should be inspected for leaks at the joints and repaired to prevent the discharge of odour containing air.

2.4.5 Rendering Plant Wet Processing Area Ventilation

The air flow into the Wet Processing Area from outside when the north roller door was open was measured and found to be a bit feeble compared to what it has sometimes been in the past. As has been found in the past, there is a zone on the west side of the door where a back eddy can release air from inside under some wind conditions.

At the time of inspection, any odour that might have occasionally exited the door was a fresh wet area type odour in contrast to more of a rotten type odour that was experienced at the last inspection.

The wet area piping should be checked to ensure the air inlets are where the main generated odour is and that there are no other (unintentional) openings in the ducting which could be drawing air in.

We trust that the above information is of assistance.

Regards

John Vickerman
Mechanical Engineer.

Appendix A
Figures & Tables

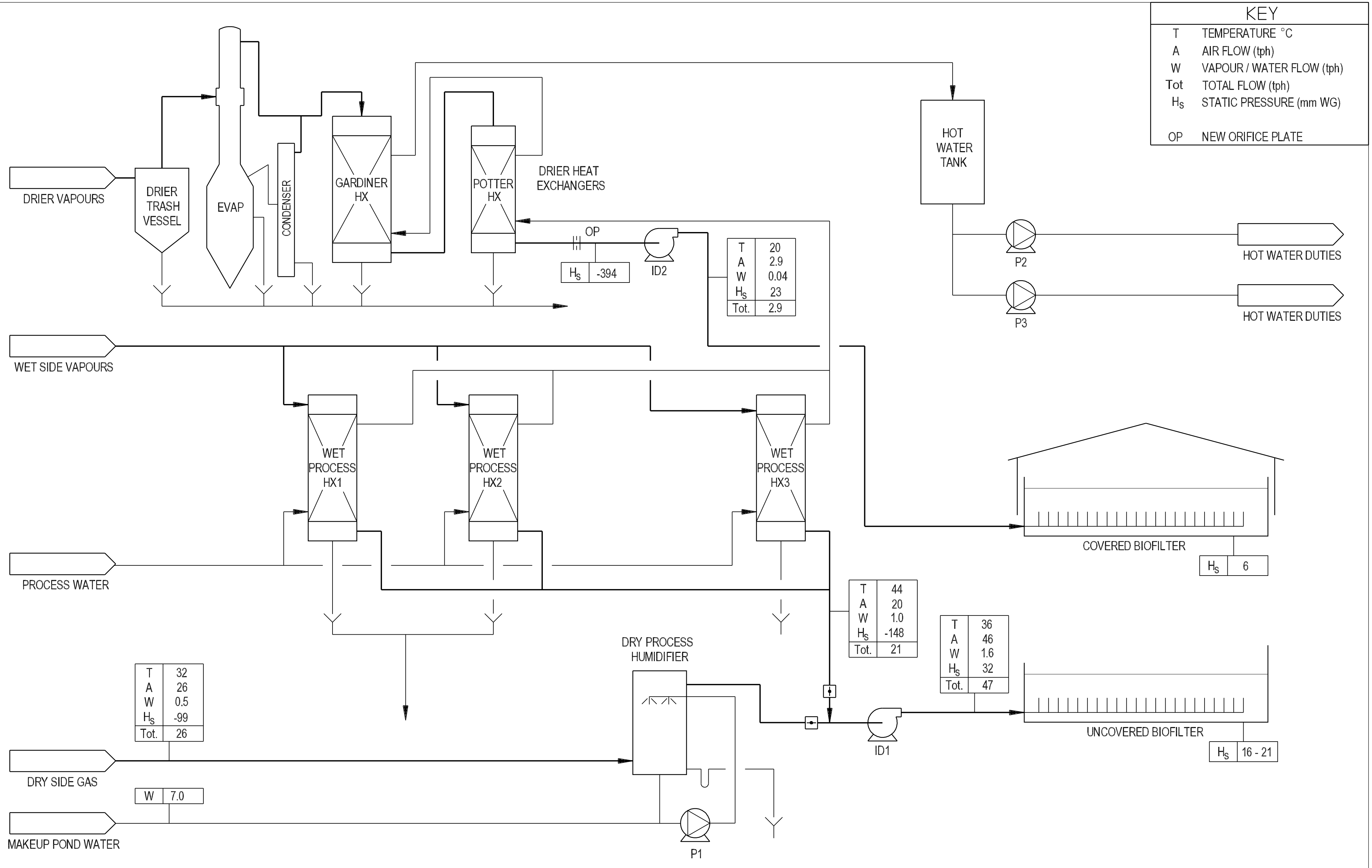

Fig 1. Biofilter Systems at AFFCO Imlay Plant May 2016

Table 1: AFFCO Imlay - Covered Biofilter

Performance Assessment 4 May 2016

Data gathered between 1350h and 1900h 4/05/16

A **Ambient Conditions**

On site temperatures (open air)	17	to	23	°C
Humidity (site open air)	55	to	75	%RH
Atmospheric pressure	102.1	to	102.1	kPa
Wind - Light N then NW	4	to	5	m/s
Occasional wind gust to 7 m/s				

B **Measured Air Flow to Covered Biofilter** (at thermowell approx 6m downstream of ID2 fan)

	Duct Diameter mm	Static Head mm wg	Dynamic Head pitot mm wg	Air °C	Manometer Water °C	Barometric Pressure kPa	Pitot Coefficient	Duct Moist Air Density kg/m^3	Air Velocity m/s	Air Flow m^3/h	Air Flow kg/s	Air Flow tph
Max Air Flow	302	24	5.5	20.1	21	102.1	1.00	1.20	9.5	2,443	0.81	2.9
Min Air Flow	302	21	5.5	19.3	20	102.1	1.00	1.21	9.4	2,433	0.82	2.9

C **Covered Biofilter Characteristics**

Length	14.8	m
Width	13.0	m
Min media depth	0.45	m
Media bed area	192	m^2
Media volume	87	m^3

Media Moisture Analysis

%w/w (wet basis)

	NW	NE	
NW	42.6	61.8	NE
SW	46.5	45.8	SE

River Side

Media Temperature

°C at 200 mm depth

NW	18.2	18.5	19.3	NE
SW	21.2	20.8	20.3	SE

River Side

Media pH

NW	6.0 - 6.5	7.0 - 7.5	NE
SW	6.0 - 6.5	6.5 - 7.0	SE

D **Biofilter Loading**

28 m^3/h air per m^3 media

E **Duct Static Pressure**

ID2 Fan Inlet static head	-394	mm wg
ID2 Fan Outlet static head	23	mm wg
Biofilter end manhole static head	6	mm wg

Table 2: AFFCO Imlay - Uncovered Biofilter

Performance Assessment 4 May 2016
Data gathered between 1350h and 1900h 4/05/16

A **Ambient Conditions**

On site temperatures (open air)	17	to	23	°C
Humidity (site open air)	55	to	75	%RH
Atmospheric pressure	102.1	to	102.1	kPa
Wind - Light N then NW	4	to	5	m/s
Occasional wind gust to 7 m/s				

B **Measured Air Flow to Uncovered Biofilter**

At removable plug 8m downstream of fan

	Duct Diameter mm	Static Head mm wg	Dynamic Head PDL pitot mm wg	Air °C	Manometer Water °C	Barometric Pressure kPa	Pitot Coefficient	Duct Moist Air Density kg/m^3	Air Velocity m/s	Air Flow m^3/h	Air Flow kg/s	Air Flow tph
Max Air Flow	898	32	19	36.3	21	102.1	1.00	1.13	18.2	41,460	12.96	46.6
Min Air Flow	898	32	17	34.5	21	102.1	1.00	1.13	17.1	39,078	12.30	44.3

C **Uncovered Biofilter Characteristics**

Length	36.0	m
Width	35.7	m
Min media depth	0.55	m
Media bed area	1285	m^2
Media volume	707	m^3

Media Moisture Analysis

%w/w (wet basis)

NW	35.0	37.9	NE
SW	30.9	34.5	SE
	River Side		

Media Temperature

°C at 200 mm depth

NW	30.1	28.8	30.1	NE
	28.3	28.4	30.7	
SW	27.9	27.4	26.8	SE
		River Side		

Media pH

NW	5.5 - 6.0	6.5 - 7.0	NE
SW	6.0 - 6.5	6.5	SE

D **Biofilter Loading**

59 m^3/h air per m^3 media

Table 2 continued: AFFCO Imlay - Uncovered Biofilter

E Measured Air flow from Wet Process Heat Exchangers

	Duct Size W x H mm		Static Head mm wg	Dynamic Head PDL pitot mm wg	Air °C	Manometer Water °C	Barometric Pressure kPa	Pitot Coefficient	Duct Moist Air Density kg/m^3	Air Velocity m/s	Air Flow m^3/h	Air Flow kg/s	Air Flow tph
Max Air Flow	645	790	-148	6	44.5	21	102.1	1.00	1.07	10.5	19,265	5.70	20.5
Min Air Flow	645	790	-148	5.5	43.5	21	102.1	1.00	1.07	10.0	18,393	5.47	19.7

F Measured Air Flow into Dry Gas Scrubber

	Duct Diameter mm	Static Head mm wg	Dynamic Head PDL pitot mm wg	Air °C	Manometer Water °C	Barometric Pressure kPa	Pitot Coefficient	Duct Moist Air Density kg/m^3	Air Velocity m/s	Air Flow m^3/h	Air Flow kg/s	Air Flow tph
Air Flow	702	-101	15	32.0	21	102.1	1.00	1.16	15.9	22,170	7.14	25.7
	702	-98	14	29.7	21	102.1	1.00	1.17	15.3	21,327	6.93	25.0

E Duct Static Pressure

ID1 Fan Inlet static head	-150	mm wg
ID1 Fan Outlet static head	32	mm wg
Biofilter SW branch end static head	21	mm wg
Biofilter NW branch end static head	16	mm wg
Biofilter N branch end static head	16	mm wg
Biofilter NE branch end static head	11	mm wg
Biofilter SE branch end static head	18	mm wg

Table 3: AFFCO Imlay - Rendering Plant Historical Air Extraction Data

	2008	2010	2011	2012	May-13	Dec-13	2015	2016
Drier Vapours								
Fan ID2 inlet static pressure (mm wg)	-312	-302	-290	-285	-228	-201	-400	-394
Fan ID2 outlet static pressure (mm wg)	83	80	101	123	140	136	13	23
Fan ID2 outlet air temperature (°C)	27	28	29	22	26	26	23	20
Covered Biofilter inlet total pressure (mm wg)	4	13	37	59	97	84	8	6
Flow to Covered Biofilter (m^3/h)	3,600	3,700	3,500	3,800	3,000	3,100	1,600	2,400
Mass flow to Covered Biofilter (tonnes/h)	4.3	4.3	4.1	4.5	3.5	3.6	1.9	2.9
Biofilter Loading (m^3/h air per m^3 media)	47	42	40	40	35	33	19	28
Non-Drier Vapours								
Dry Side Air								
Humidifier Inlet Static Pressure	-83	-83	-77	-95	-98	-88	-79	-99
Humidifier Inlet Temperature (°C)	32	35.1	30.4	24.1	27	30	32	31
Inflow to Humidifier (m^3/h)	24,900	20,300	20,700	22,100	22,800	28,000	22,800	22,300
Mass flow to Humidifier (tonnes/h)	29.2	22.5	23.9	25.9	26.6	31.7	26.6	25.2
Wet Side Vapours from HX1 - HX3								
Static pressure (mm wg)	-123	-119	-93	-118	-131	-108	-125	-148
Temperature (°C)	35	46.1	43.7	37.5	41	39	46	44
Flow (m^3/h)	20,400	20,800	16,600	15,100	19,100	14,400	19,400	19,200
Mass flow (tonnes/h)	22.5	19.4	17.8	16.6	20.7	15.8	20.3	20.3
Uncovered Biofilter								
Fan ID1 outlet static pressure (mm wg)	40	56	138	68	58	52	45	32
Air temperature to Uncovered Biofilter (°C)	33	22.5	31.5	26.6	32.4	31.2	34	35
Flow to Uncovered Biofilter (m^3/h)	44,800	41,300	37,500	39,900	43,500	43,200	41,800	41,400
Mass flow to Uncovered Biofilter (tonnes/h)	51.7	44.3	43.5	46	49	49	46	46
Biofilter Loading (m^3/h air per m^3 media)	63	58	53	56	62	62	59	59