

Annex V: Cesspit Inspection Report



CESSPIT CERTIFICATION FOR IMPERMEABILITY AND CAPACITY
S.L. 549.63

Page 1 of 2

Cert # 19-09-033

General info	
RESPONSIBLE PERSON (OR OWNER) OF PREMISES ADDRESS	The CEO Wasteserv Ekocentre, Latmija Road, Marsaskala, MSK 4613
ADDRESS OF CESSPIT LOCATION	Cesspit Located in the Shredder Room.
CESSPIT IDENTIFICATION AND LOCATION	Thermal Treatment Facility, Marsa.
NATURE OF LIQUIDS CONTAINED	The Cesspit gathers Hot Process Water that containing residues. This water enters the Hot Water Compartment so as to pass through a Primary Sedimentation Process. The top water layer then overflows to the Discharge Compartment where a Secondary Sedimentation Process occurs. Upon completion of this Secondary Sedimentation Filtering Process, the water then overflows into the Sewers.
CESSPIT LINING	The Cesspit is constructed from Welded Stainless Steel 316 Grade Sheets. During the inspection one could see No Signs of Deterioration or Corrosion/ Rusting of the Cesspit Wall lining.
IMPERMEABILITY TEST	The Cesspit located in the Shredder Room was filled to the Upper liquid level with water for the duration of Eight hours. No loss in the level of water was witnessed.
CESSPIT CAPACITY	The Cesspit has a total approximate volumetric capacity of 4.1m ³ . Hot Water Compartment is 1.3m ³ and the Discharge Compartment is 2.8m ³ .
CESSPIT WATER CONTAINMENT LEVEL DIMENSIONS	The Hot Water Compartment has an approximate water containment level dimensioning of 0.9 m by 1.0 m by 1.45 m height and the Discharge Compartment has an

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	CESSPIT ROOFING AND VENTILATION	approximate water containment level dimensioning of 0.9 m by 2.4 m by 1.3 m height. The Cesspit Roofing is made of Welded Stainless Steel 316 Grade Mesh to enhance ventilation.
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I CERTIFY THAT ON THE 17.10.2019 I HAVE TESTED THE ABOVE CESSPIT FOR IMPERMEABILITY AND CAPACITY CALCULATED AND THAT AS FAR AS ASCERTAINABLE THE ABOVE IS A TRUE REPORT OF THE RESULT.

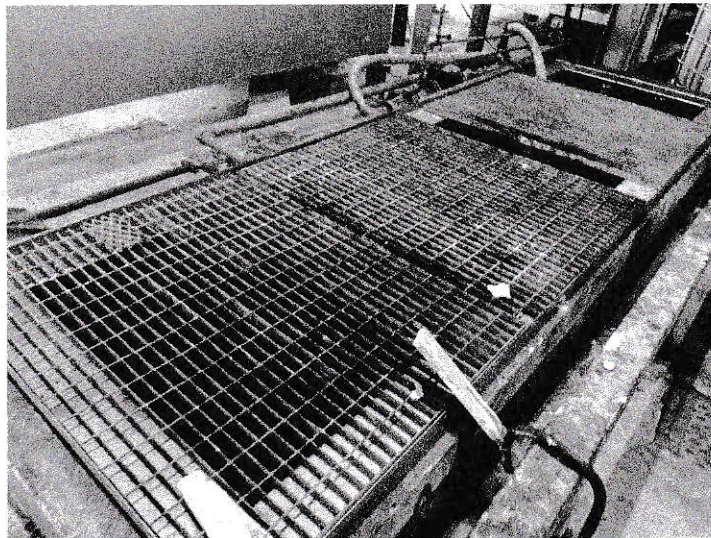
CERTIFICATE ISSUE DATE: 17.10.2019

NEXT INSPECTION DATE: 12 MTHS FROM INSP. DATE

ING. NOEL BONELLO
B.ENG (HONS)
WARRANT No: 720

ING. NOEL BONELLO
B.ENG (HONS)
WARRANT No: 720

FOR OFFICE USE ONLY



Cesspit

Annex VI: WWTP Contingency Plan

Contingency Plan for the Waste Water Treatment Plant at the TTF in Marsa

Drafted by: **Ing. Ryan Cauchi**

Date: **06.03.2019**

Report Reference: **RC06032019**

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1. Introduction

In January 2016, Wasteserv inaugurated the Autoclave plant. The said plant, which forms part of the Thermal Treatment Facility (TTF) in Marsa, was built to render animal by-products and fallen animals. The plant consists of an unloading area, refrigerated storage, two rendering lines (CAT 1 and CAT 2&3) and a Waste Water Treatment Plant (WWTP).

Wasteserv has submitted a Water Discharge Permit Application to Water Services Corporation (WSC) for the TTF. WSC forwarded Wasteserv a Voluntary Undertaking document which is designated to ensure compliance with L.N. 378 of 2005.

2. Scope

One of the elements of the Voluntary Undertaking is the provision of a preliminary contingency plan. This document describes this plan.

3. Elements of the WWTP

The WWTP involves the below treatment steps.

- Lifting station
- Fine Screening
- Primary Clarification
- Biological Treatment
- Secondary Clarification
- Tertiary Clarification
- Disinfection

4. List of Spare Parts

Following the plant manufacturer's recommendations, Wasteserv kicked-off the procurement process and acquired and stored the spare parts listed in Annex 1.

A system of minimum stock level shall be maintained such that when a part is consumed, a replacement is ordered straightway.

5. Modus Operandi

In case of plant malfunction or shutdown, a fault finding exercise is immediately executed. Once the root cause is identified, the necessary spare parts are prepared such that fault is repaired. Wasteserv has the necessary resources (manuals, technical know-how & spare parts) to effect the necessary repairs in the shortest time possible.

In case of a major fault that dictates that the plant is not operational for a long period of time, Wasteserv shall reach out to the local representative of the manufacturer of the plant who can assist Wasteserv in less than 24 hours. At this point, it is also worth pointing out that the manufacturer of the plant is bound to visit the plant every 6 months to perform inspection and servicing.

6. Future Plans

Wasteserv is currently conducting an exercise to catalogue and characterise the waste waters from its various sites. Following this undertaking, solutions to treat the waste waters shall be identified and a pilot trial coordinated. Following positive identification of the most suitable technology, the plan is to build an industrial plant which can process the said waste waters. Timeline of interest is replicated in Annex 2.

Once the aforementioned plant is commissioned, it can serve as backup to the WWTP at the TTF, and should extreme situations at the TTF (example: long downtime), waste waters collected can be diverted to this new plant.

Annex 1

Code	Description	Quantity
1	Xylem-Lowara Submersible Pump DOMO 20VXT kW 1,5 380V 3P for R-Grid 500 rotary screen feed	1
2	2-Wire Floating Level Switch	3
3	PP/AIS 1304 Brushes set for R-Grid 500 rotary screen	1
4	Mechanical seal set for Satpump 5.5/c for U-OAF 1500	1
5	Satpump 5,5/c stainless steel AISI316L 5,5 kW 380V 3P motor for U-OAF 1500	1
6	Saturation Pressure Transducer 4-20 mA 0-10 bar for U- OAF 1500	1
7	pH Probe Electrode, epoxy/gel, BNC connector, 6 meters cable for U-DAF 1500	1
9	NaOH Electromagnetic Diaphragm Metering Pump PVDF maintenance set for U-DAF 1500	1
10	NaClO Electromagnetic Diaphragm Metering Pump PVDF maintenance set for Disinfection	1
11	Polyelectrolyte Plunger Metering Pump FPM maintenance set for L1-DAF 1500	1
12	Sludge Scraper Blade stainless steel AISI304 set for U- OAF 1500	2
13	Joint Link stainless steel AIS 1304 for Sludge Scraper Chain with Blade Connector for U-DAF 1500	4
14	Air Feed Solenoid Valve 1/8" 24 Vac for U-OAF 1500	1
15	Submersible Level transducer for S.8.R. biological section	1
16	Transmission V-Belts set for Blowers S.B.R.-E.A.S. biological section	2
17	Air Filters section for Blowers S.B.R.-E.A.S. Biological	2
18	Mechanical seal set for S.B.R.-E.A.S. biological section recirculation pump SAER BP BA kW 5,5 380V 3P	1
19	Centrifugal feed pump for S.8.R.-E.A.S. biological section recirculation pump SAER BP 8A kW 5,5 380V 3P	1
20	Mechanical seal set for S.B.R.-E.A.S. biological section feed pump SAER BP8CkW3380V3P	1
23	Centrifugal extraction pump for S.B.R.-E.A.S. biological section SAER BP 11NB kW 4 380V 3P	1
24	PVC-U Diaphragm valve d.40 (piping spare)	2
25	PVC-U Diaphragm valve d.63 (piping spare)	2
26	Control Solenoid Valve 1/8" 24 Vac for CLARO	2
27	Saturation Pressure Transducer 4-20 mA 0-6 bar for CLARO	1
28	Quartz Tubes set for U.V.C. Sterilizer	2
29	Low Pressure U.V.C. Fluorescent Lamps set for U.V.C. Sterilizer	1

30	NBR outer casing for sludge extraction progression cavity pump	1
31	Chemicals Low level Switches (contactless reed switch type)	2
32	Schneider Thermal Overload Protection (control board spare)	4
33	Omron Relay 24Vca (control board spare)	3
34	PEAD hose 6 x 4 for chemicals	20
35	PEAD hose 12 x 8 for chemicals	50
36	PAll hose 6 x 4 for air supply and distribution (10 mt roll)	1
37	Bonfiglioli Worm Gearbox VF complete with 380V 3P Electric Motor for R-Grid 500 rotary screen feed	1
38	Bonfiglioli Worm Gearbox VFR complete with 380V 3P Electric Motor for U-OAF 1500 sludge scraper	1

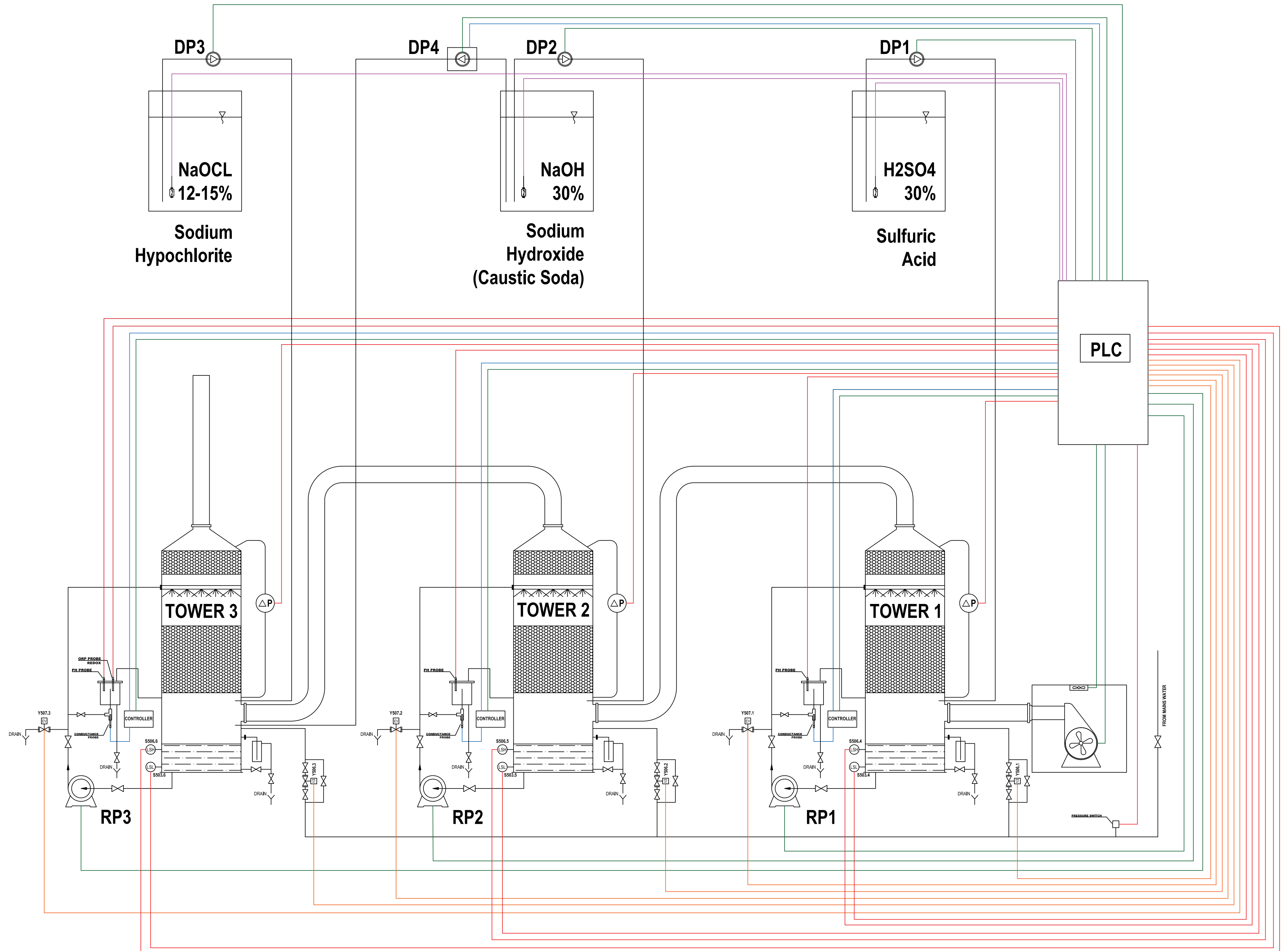
Annex 2

Tentative plan for the construction and commissioning of waste water treatment plant.

Year						
2019	2020	2021	2022	2023	2024	2025

Legend	
	Development permit
	Construction
	Commissioning

Annex VII: Air Scrubber System PID



Annex VIII: Autoclave Boiler Specifications

3.1 SERIAL PLATE DATA

Plate field	Description	Plate data
CE_____	Identification number of Notified body	0066
PRESSIONE MASSIMA MAX PRESSURE	Maximum allowable pressure	12 bar
PRESSIONE MINIMA MIN PRESSURE	Minimum allowable pressure	0 bar
PRESSIONE REGOLAZ. VALVOLA DI SICUREZZA SAFETY VALVE SET PRESSURE	Safety valve set pressure	12 bar
CAPACITÀ TOTALE TOTAL WATER CONTENT	Total water content	9900 lt
TIPO/MODELLO TYPE/MODEL	Model	PB 50 EU
ANNO DI FABBRICAZIONE YEAR OF MANUFACTURE	Year of manufacture	2015
PRESSIONE PROVA IDRAULICA HYDROSTATIC TEST PRESSURE	Hydrostatic test pressure	18 bar
DATA PROVA IDRAULICA HYDROSTATIC TEST DATE	Hydrostatic test date	28/ 04/ 2015
TEMPERATURA. MASSIMA MAX TEMPERATURE	Maximum allowable temperature	191,5 °C
TEMPERATURA. MINIMA MIN TEMPERATURE	Minimum operating temperature	21°C
SUPERFICIE SURFACE	Heated surface	100 m ²
POTENZIALITA' HEAT OUTPUT	Heat output to water	3488 kW
NUMERO DI FABBRICA SERIAL NUMBER	Serial number	9902

Annex IX: Incinerator Specifications

1. **Recovery boiler**, water-tube steam generator for the production of saturated steam.

Technical specifications:

▪ EXCHANGE SURFACE	262	m ²
▪ HEAT EXCHANGED	3,381,000	kcal/hr \approx 3,931 Kw
▪ MAX. PRODUCTION OF SATURATED STEAM	6,576	kg/hr
▪ FUMES EXIT TEMPERATURE	300	°C
▪ TUBES ARRANGEMENT	vertical	
▪ TUBES LAYOUT	not staggered	
▪ LOAD LOSS FUMES SIDE	75	mm H ₂ O
▪ TEMPERATURE OF SUPPLY WATER	155 ÷ 160	°C

Structural features:

"Water-tube" boiler with vertical tubes arranged in a "Ω" shape (that is, connected at the top to a single main cylindrical body characterised by the "evaporating water" and "steam" phases and, at the bottom, to another two cylindrical bodies respectively), a configuration which guarantees a high ratio of circulation between the delivery tubes and which is also executed on each level of the various banks and in the direction of the gas current.

The gases in transit run through the exchanger in a single passage, without the intervention of deflecting baffle plates being provided, which would encourage the accumulation of ashes or residues that are difficult to remove.

The banks are set out in parallel rows with two easily accessible areas to facilitate inspections and control and maintenance operations. The tube used is in carbon steel without welding, 60.3 x 3.2 in diameter, Fe 35.2, C14 type or similar but always in compliance with EN regulations.

A steel plate (laminar system) is welded between the external tubes of the various banks to guarantee the fume sealing and, to that end, the insulation, apart from in the inspection areas, is made from rock wool and corrugated containment sheet.

Suitably shaped plates will be inserted into the main cylindrical body to separate the connection area of the delivery tubes from that of the evaporating tubes, while a special "demister" will be provided to guarantee steam completely saturated at the output.

The front fume chamber is vertical, equipped with a top inlet positioned immediately above the upper cylindrical body. It is internally insulated with a double layer of insulating and refractory concrete in order to limit its heat dispersion and it is provided with a bolted inspection hatch.

The volume that characterises this chamber [internal dimensions 1,000 x 1,150 mm] allows the ashes and waste to be separated from the fumes that transport them, facilitating their outflow at right angles to the boiler axis and creating, near the inlet area, a sort of "settling" chamber. This chamber has the dual function of improving the distribution of the gaseous flow in the entire front area of the tube bundle and, at the same time, facilitating the deposit of the waste into the collecting hopper that the chamber has in its lower part, a hopper which is equipped with a double combined discharge damper in order to prevent air from penetrating to the inside.

The rear fume chamber [internal crosswise dimensions 500 x 1,000mm], also extending vertically, enables the fumes to exit from above towards the economizer and is provided with a bolted inspection hatch.

The lower part of the boiler has a special support structure made up of sturdy, rigidly connected beams. The ash discharge hopper is located on the special extension; it is internally coated with refractory material, and has sloped walls to prevent the accumulation of the ashes and waste that are separating from the fumes. The hopper is divided into sections by special vertical partitions distanced from one another to prevent the "false" circulation of fumes with consequent load losses, while a central partition divides the discharge area into two very distinct parts in order to be able to supply the two opposing ash extraction

screws (a solution which avoids the use of a single screw which, because of the dimensions it would have to take, would become a critical point).

The discharge outlets of the two extraction screws are then connected to a third screw which takes care of the definitive removal of the ashes towards the centralised collection point for waste and waste reactants (?).

The steam generator is accompanied by the following accessories:

No. 4 Rotating/retractable soot blowers, composed of

- Main body in a single steel casting,
- Flux opening valve controlled by rotating system,
- On-off and steam regulation valves,
- Steam closing device for end of cycle with complete seal to prevent drawing;
- Blowing lances, with multiple nozzles for high temperatures, interlocked with the bank structure; during the "out of use" phases, the extraction of a part of the lance is foreseen to prevent possible obstructions in the nozzles.
- Command and control system with modifiable programming from keyboard on the field (on, off, flux control, rotation) for each blower; can operate with a differentiated sequence depending on the level of dirt on the relative bank.

No. 1 PN16 Directed flow steam valve

Directed flow safety valves with conveyed discharge

No. 1 Supply unit with Gestra valves

No. 1 Boiler discharge unit with plug valves and directed flow valves

No. 1 Differential adjustment pressure switch, settable and variable

No. 1 Safety pressure switch with 0÷20 mA output signal to adjustment and safety system

No. 1 Pressure gauge complete with accessories

No. 2 "Klinger" reflector level gauges complete with accessories

No. 1 Steam valve for blowers

No. 1 System of valves with a filter for group of no. 2 continuous adjustment valves for H₂O supply to the cylindrical body and bypass valves to degasser

No. 1 Italian and European regulation level adjuster

No. 1 Salinity meter for maintaining the correct salinity in the boiler's contents

Various attachments.

Access ladder to on-field instruments and inspection hatches, and walkway with handrail, produced in compliance with the legislation in force, to access the on-field instruments and inspection hatches.

2. **Economizer**, connected to the generator described above, it aims to lower the temperature of the fumes by a further 100÷120°C by heating the supply water and/or the condensations.

Technical specifications:

▪ EXCHANGE SURFACE	55	m ²
▪ MAX. PRODUCTION OF SATURATED STEAM	6,800	kg/hr
▪ FUMES ENTRANCE TEMPERATURE	300	°C
▪ FUMES EXIT TEMPERATURE	180	°C
▪ TUBES ARRANGEMENT	vertical	
▪ TUBES LAYOUT	staggered	
▪ LOAD LOSSES FUMES SIDE	40 mm H ₂ O	
▪ WATER TEMPERATURE AT ENTRANCE	104 ÷ 110	°C
▪ WATER TEMPERATURE AT EXIT	158 ÷ 168	°C
▪ MAX. WATER FLOW RATE	7000	kg/hr
▪ PRESSURE	12	bar

Structural features:

6.4 Exhaust gases

From the application main menu choose the "Gases" menu: you will get the following submenus:

Total Dust	Each submenu gives access to the graphic page representing the chosen exhaust gas emission to air from the incinerator chimney. The three bar graphs are the histograms related to last 24 hours, the day before and last month values. In the daily graph (graph 1 and 2) each bar represents the average value over 30 minutes, while in the monthly graph (graph 3) each bar represents the daily average value. The yellow and red horizontal lines represent the law emission limits for the specific gas.
VOC as TOC	
HCl	
SO ₂	
NO _x	
CO	

fig. 11 gases submenus

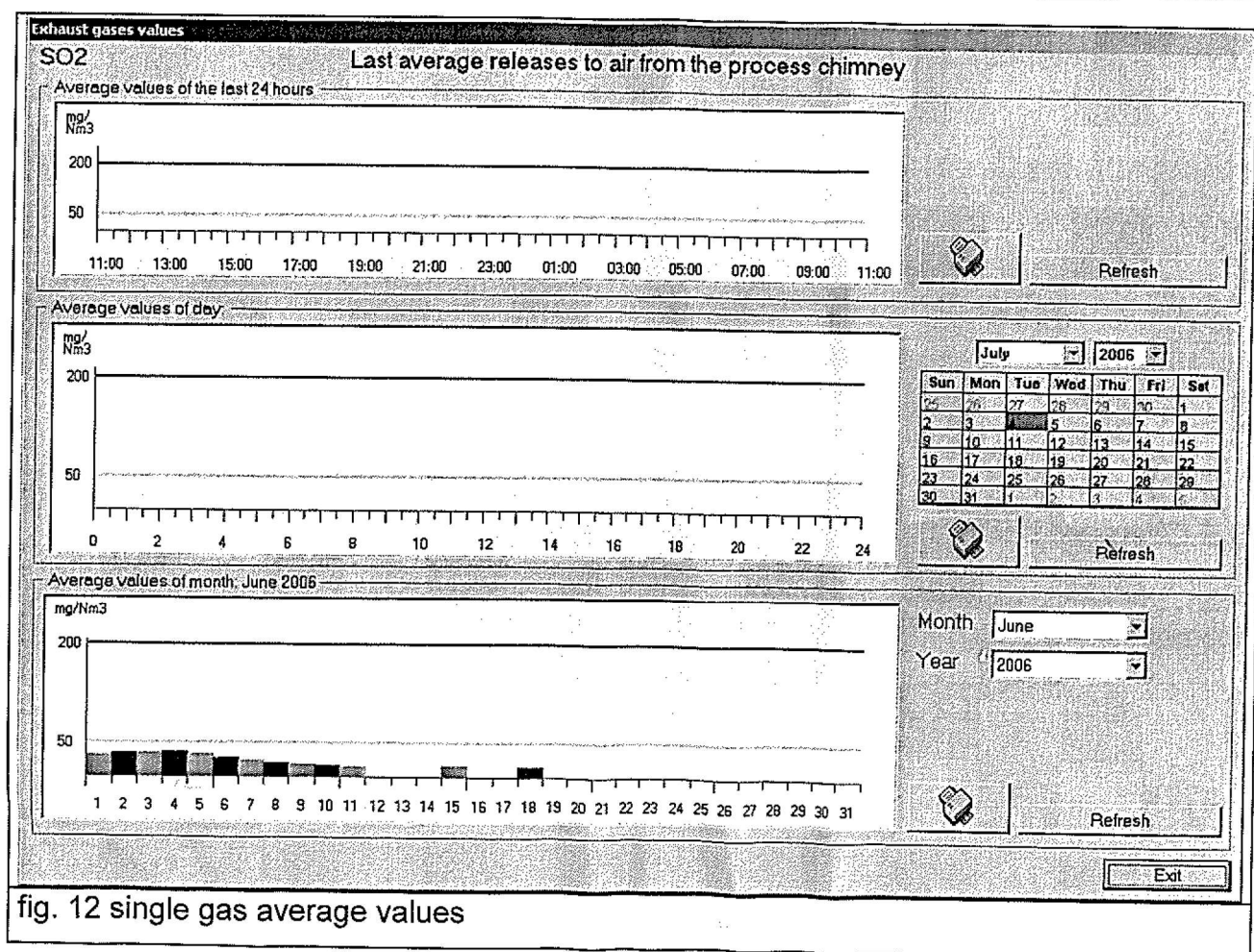


fig. 12 single gas average values

To see in graph 2 values related to a different day choose a day from the calendar on the right and press the Refresh button. To see in graph 3 values related to a different month, choose a month and a year from the drop down menu and press the Refresh button. Clicking on a blue bar on any bar graph you'll get a tooltip (popup yellow rectangle) showing the value (in digits) corresponding to the clicked bar.

The Print button allow to get a print preview including bar graph and values table of the graph on the left, as shown in the picture below (fig. 13). If a datum is not available the corresponding default value is -1.

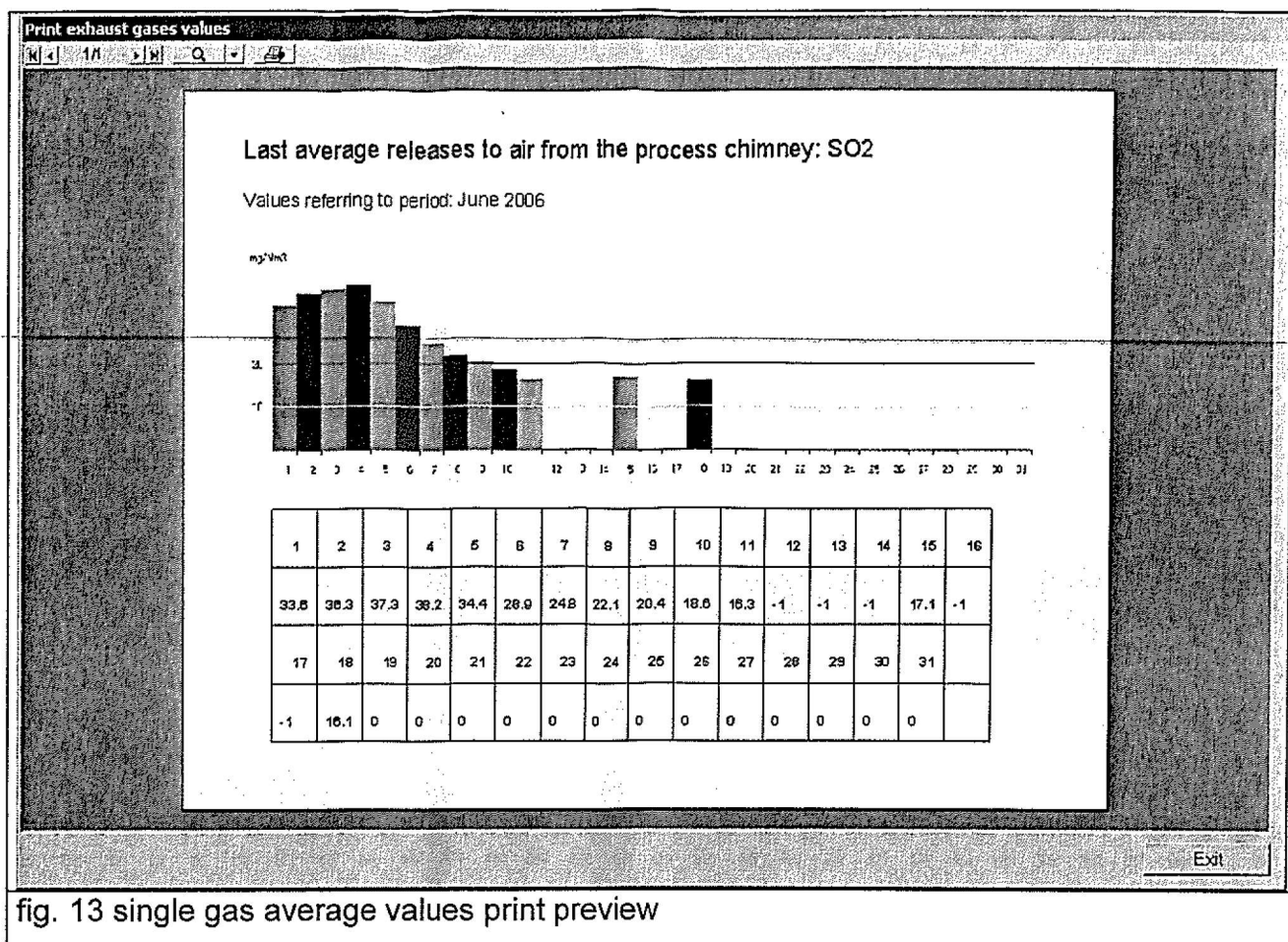


fig. 13 single gas average values print preview

6.5 Consumption

From the application main menu choose the "Consumption" menu: you will get the following submenus:

- Trend
- daily
- monthly
- Report

These menus give access to important data referring to plant consumption and production, such as burned material, burned oil, power consumption, water consumption, produced steam and output steam.

Consumption report

☐ *Daily* ☒ *Period*

(dd/mm/yyyy) (dd/mm/yyyy)

from **28/06/2006** to **05/07/2006**

☒ *No filter* ☐ *Filter through*

Execute Print

Exit

fig. 16 consumption report selection

Two list are present: a day by day list of the single elements and, at the end, a summary list for the whole period. These lists can be printed choosing printer orientation (portrait or landscape).

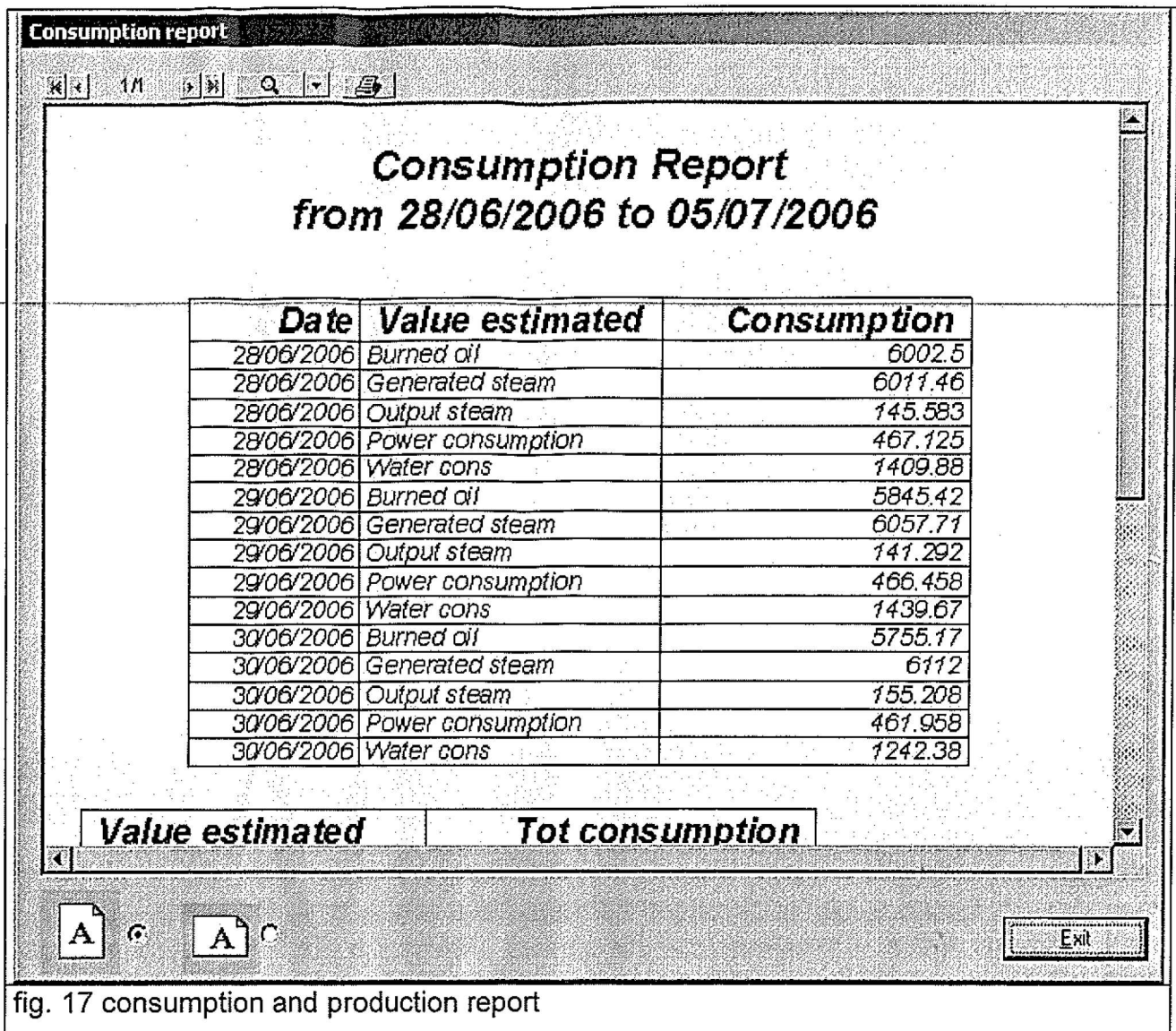
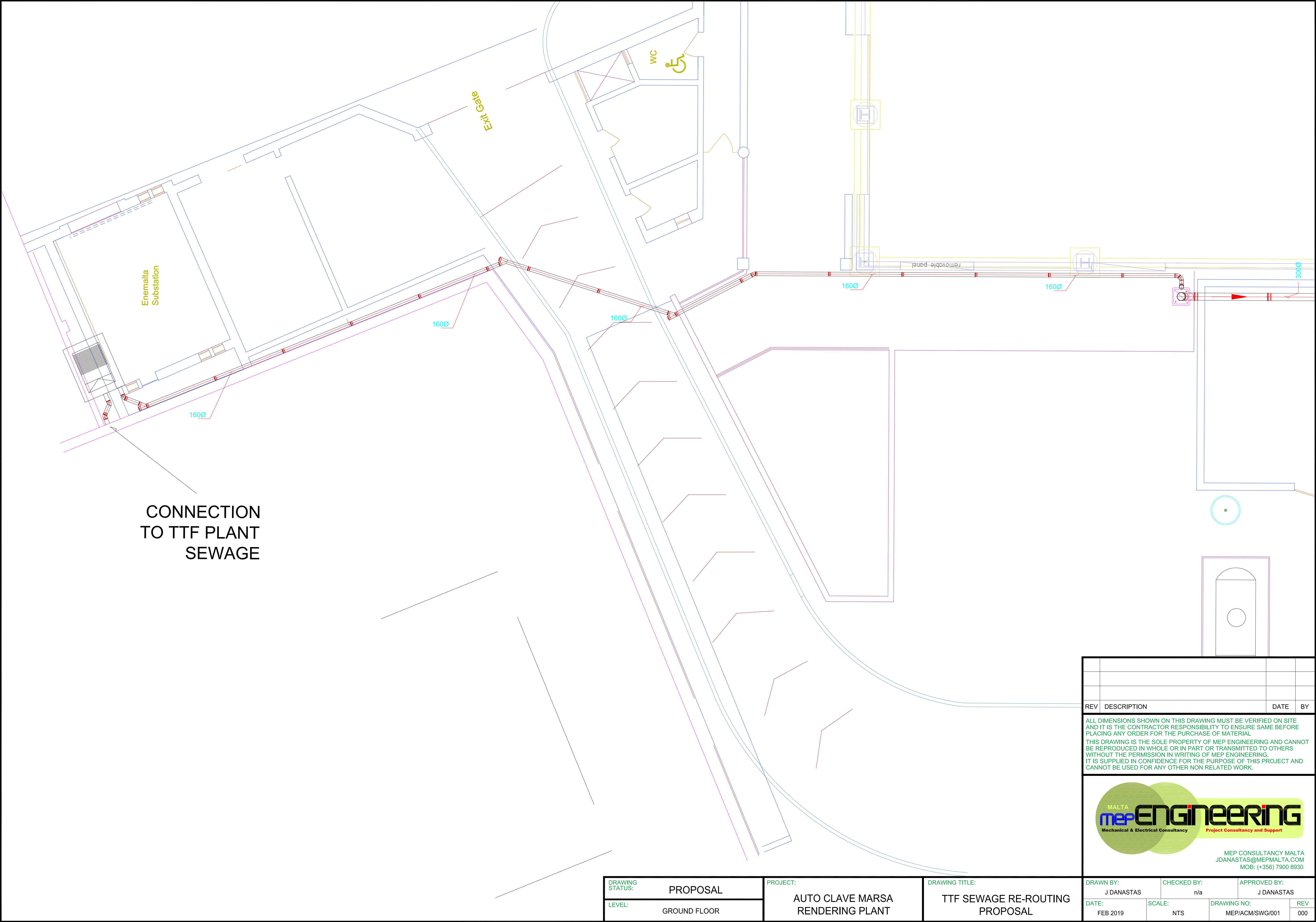
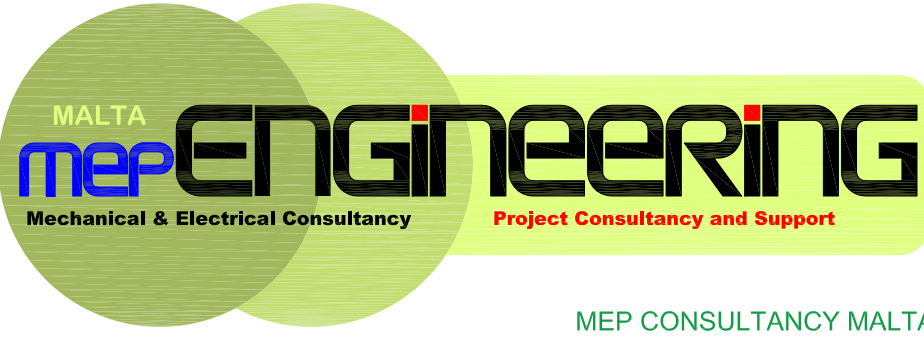


fig. 17 consumption and production report

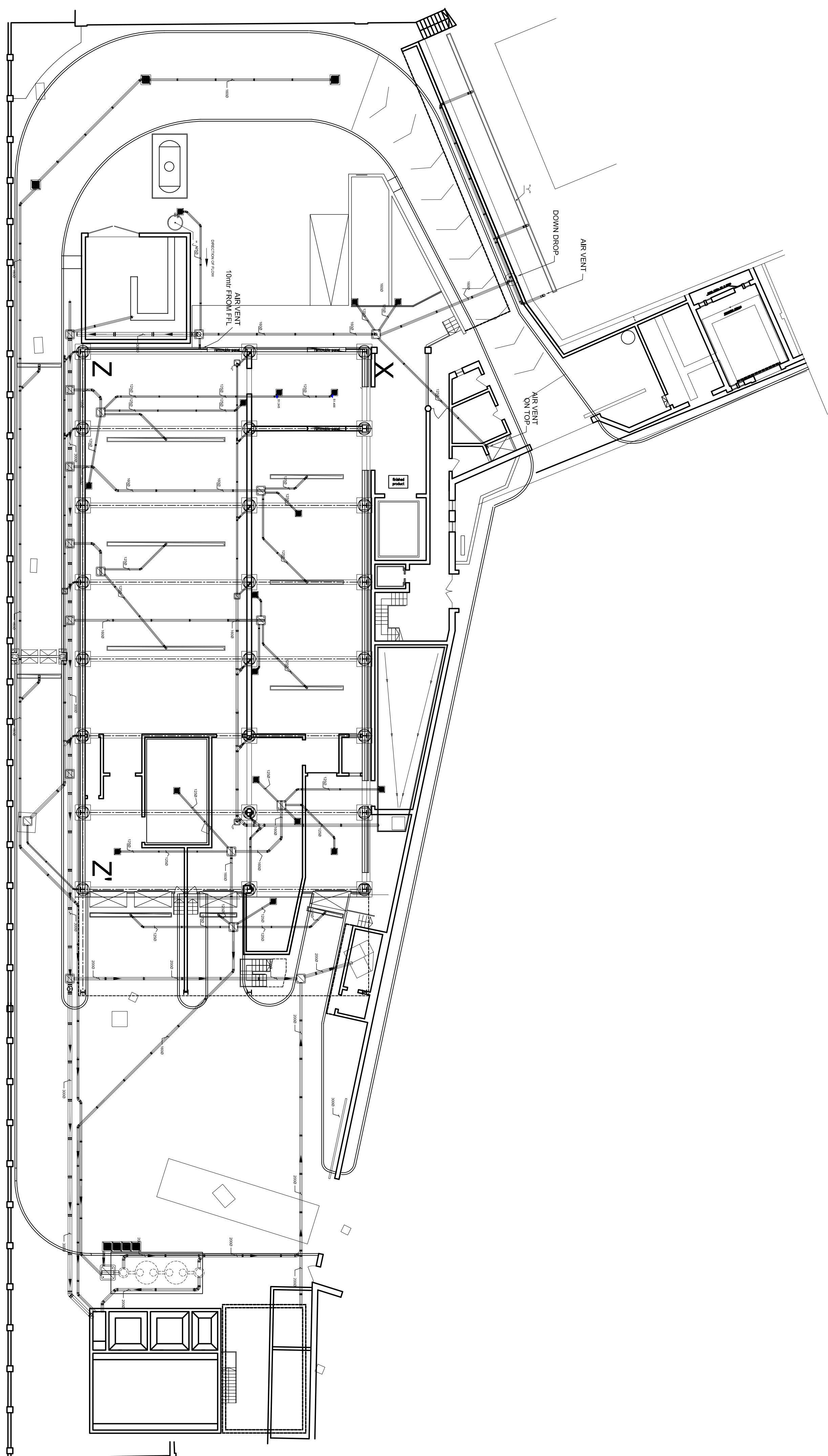
Annex X: Rerouting of Inc sewer to WWTP



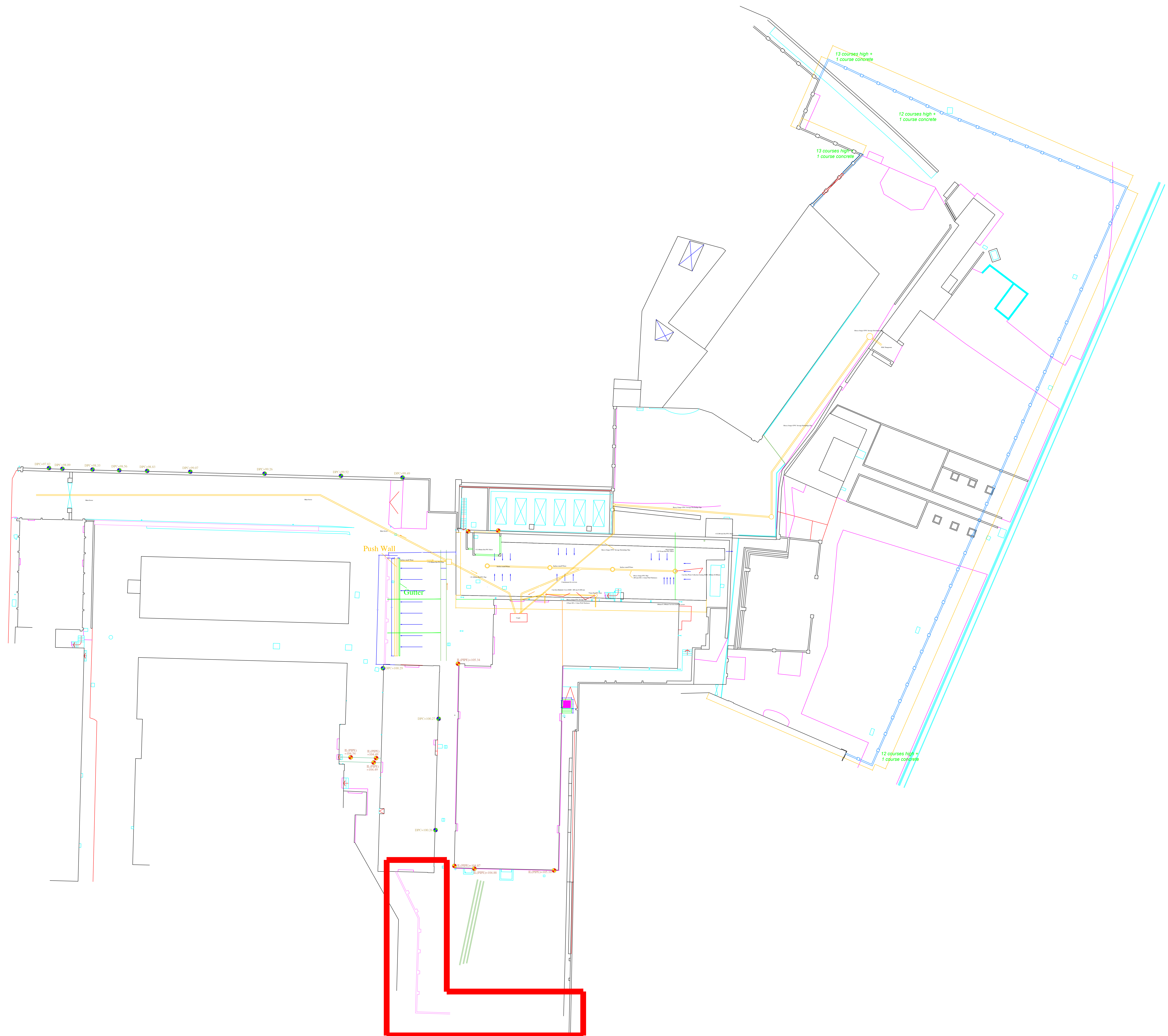
REV	DESCRIPTION	DATE	BY
ALL DIMENSIONS SHOWN ON THIS DRAWING MUST BE VERIFIED ON SITE AND IT IS THE CONTRACTOR RESPONSIBILITY TO ENSURE SAME BEFORE PLACING ANY ORDER FOR THE PURCHASE OF MATERIAL. THIS DRAWING IS THE SOLE PROPERTY OF MEP ENGINEERING AND CANNOT BE REPRODUCED IN WHOLE OR IN PART OR TRANSMITTED TO OTHERS WITHOUT THE PERMISSION IN WRITING OF MEP ENGINEERING. IT IS SUPPLIED IN CONFIDENCE FOR THE PURPOSE OF THIS PROJECT AND CANNOT BE USED FOR ANY OTHER NON RELATED WORK.			
<div><p>MEP CONSULTANCY MALTA JDANASTAS@MEPMALTA.COM MOB: (+356) 7900 8930</p></div>			
DRAWN BY: J DANASTAS		CHECKED BY: n/a	APPROVED BY: J DANASTAS
DATE: FEB 2019	SCALE: NTS	DRAWING NO: MEP/ACM/SWG/001	REV 000

DRAWING STATUS: PROPOSAL	PROJECT: AUTO CLAVE MARSA RENDERING PLANT	DRAWING TITLE: TTF SEWAGE RE-ROUTING PROPOSAL
LEVEL: GROUND FLOOR		

Annex XI: Drainage Layout at Autoclave section



Annex XII: MTTF Sewage



Annex XIII: Daily Average Dust Readings (BAT 25)

Daily average dust readings (mg/Nm ³)	
19-Feb	0.053
20-Feb	0.093
21-Feb	0.05
22-Feb	0.029
23-Feb	0.025
24-Feb	0.029
25-Feb	0.041
26-Feb	0.122
27-Feb	0.088
28-Feb	0.106
29-Feb	0.087
01-Mar	0.108
02-Mar	0.129
03-Mar	0.108
04-Mar	0.061
05-Mar	0.035
06-Mar	0.106
07-Mar	0.126
08-Mar	0.227
09-Mar	0.095
10-Mar	0.345
11-Mar	0.636
12-Mar	0.232

Average: **0.127 mg/Nm³**

Table 1 - Daily average dust readings at WSM TTF Marsa

Annex XIV: Controlling SO₂ and HCL in Flue Gas

CONTROLLING SO₂ and HCL IN FLUE GAS

HOW TO CONTROL SO₂ AND HCL GENERATION IN FLUE GAS

Two main flue gas components generated from the Incineration process are HCl and SO₂. HCl (or Hydrogen chloride) is a gas at room temperature and is characterized by its very strong acidic character and ability to dissolve in water. When dissolved in water it produces hydrochloric acid (*Actu*).

This gas is generated when organic compounds containing Chlorine are decomposed by high temperatures such as those present in an incineration plant. The amount of HCl generated is related to the concentration of Chlorine in the original waste. Most materials including meats and also tap water contain a certain amount of Chlorine. Others like PCBs (polychlorinated biphenyls) may contain up to 70-75% by weight of chlorine.

If released into the environment HCl will rapidly diffuse in air and will dissolve in any moisture it encounters thus ending up in clouds and coming down again in the form of acid rain which causes acidification of soils rendering it unfertile

SO₂ or Sulfur dioxide is also a gas at room temperature which like HCL dissolves in water giving an acidic solution and is highly corrosive.

This gas is generated during the incineration process from wastes containing sulfur or sulfur containing compounds. The produced SO₂ if not treated causes the same effects of HCL to the environment and in addition is associated with chemical weathering of steel constructions. Sulfur is contained in virtually all materials. Meat proteins contain some 1-2% Sulfur and fossil oils may contain up to 10%.

CONTROLLING SO₂ and HCL IN FLUE GAS

Sodium bicarbonate and HCl/SO₂

To contrast the acidic gases (HCL and SO₂) it is required to use an alkaline substance that will readily react with the acids. Sodium bicarbonate is a very commonly used substance, commonly called baking soda this compound is used to react with lemon juice to reduce its acidity. It is also used in medicine as a treatment for acid reflux from the stomach to remove that burning sensation.

In incineration it is used to neutralize directly the SO₂ and HCl and other acidic gases generated by the process. The solid is pumped through the dosing equipment and a cloud of dust is mixed to the incoming gases and given enough time it reacts producing CO₂ and harmless salts which end up in the fly ash. The load of acids it can take is limited thus the amount is to be calibrated with the wastes being burned. When in normal operating conditions 15-25kg/hr would be able to neutralize all the acid gases produced but in special cases extra bicarbonate is required, thus a rapid increase in Dosing is required

When SO₂ and HCL levels start increasing, the Head of Shift should do the following actions:

1. From Board M located adjacent to the Sodium Bicarbonate and Activated Carbon dosing equipment, press on the touch screen installed on the front panel of the electrical board, as shown in figure 1.

CONTROLLING SO₂ and HCL IN FLUE GAS



Figure 1 The touch screen panel on board M

2. When touching the screen, a second screen appears showing four icons as shown in figure 2. The four icons read the following:
- a. **Tempi**
 - b. **Setup**
 - c. **Velocita Stato Motori**
 - d. Exit (the icon with the door)



CONTROLLING SO₂ and HCL IN FLUE GAS

Figure 2 Screen showing the 4 icons, including the "Velocita Stato Motori"

3. The Head of Shift should touch lightly the icon reading **Velocita Stato Motori** as shown in figure 2. No password is required to change this value.

4. The next screen that appears is that of **Sodium Bicarbonate**.

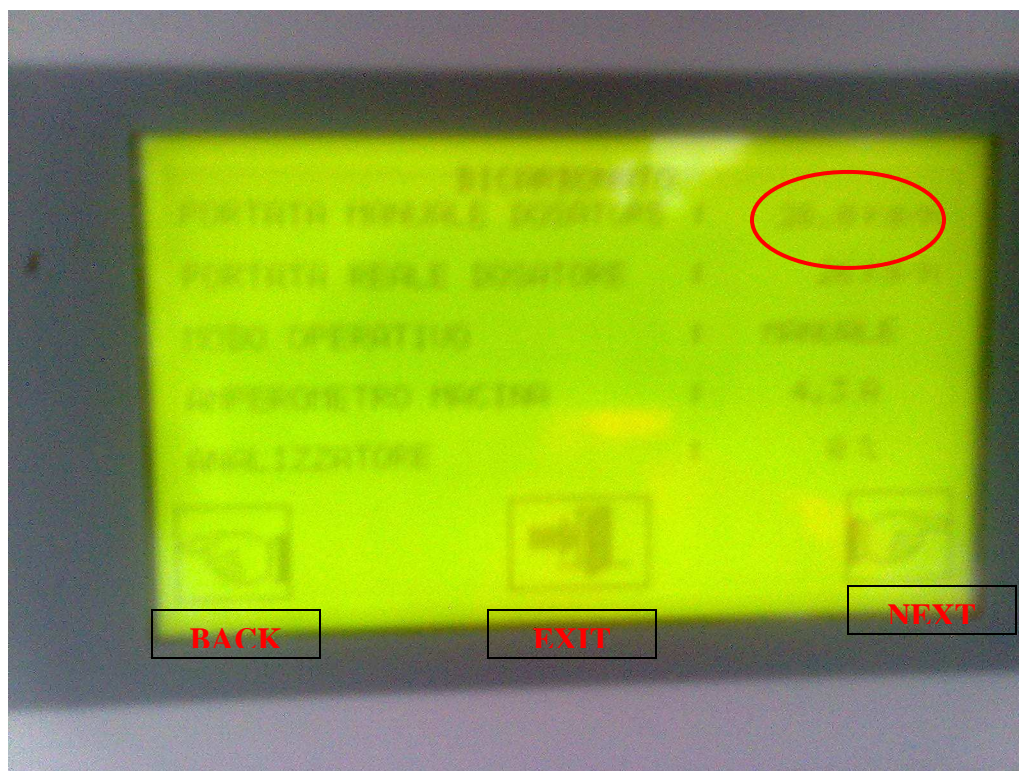
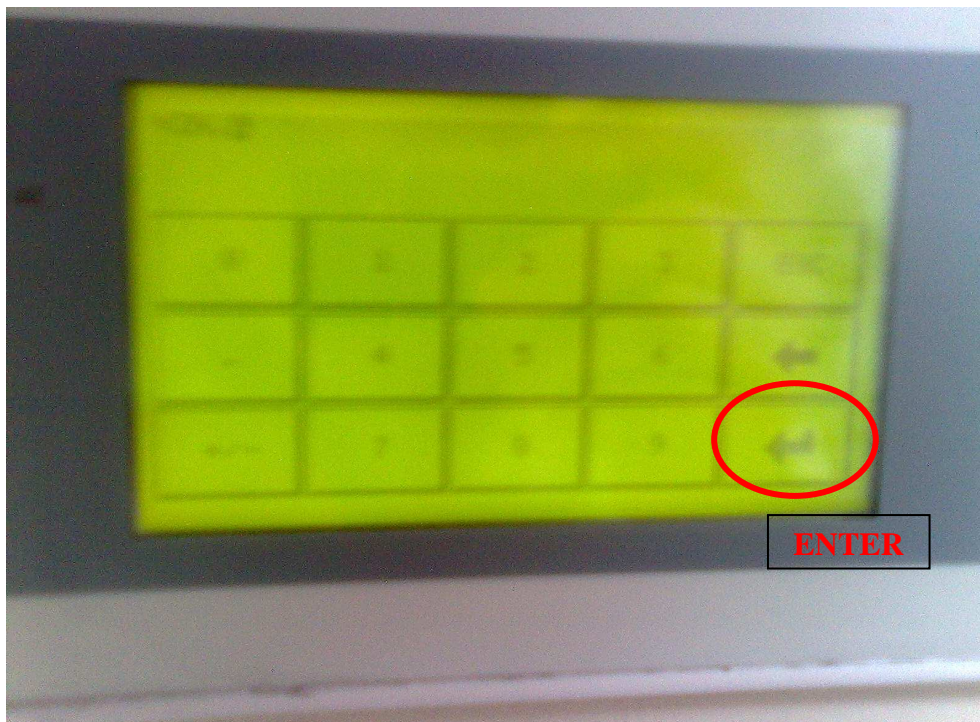


Figure 3 The Bicarbonate Dosing Rate Screen

CONTROLLING SO₂ and HCL IN FLUE GAS

5. The Head of Shift should touch lightly the first value on the right hand side adjacent to **"portata manuale dosatore"**.

6. Another screen appears immediately with an electronic numeric keyboard.



CONTROLLING SO₂ and HCL IN FLUE GAS

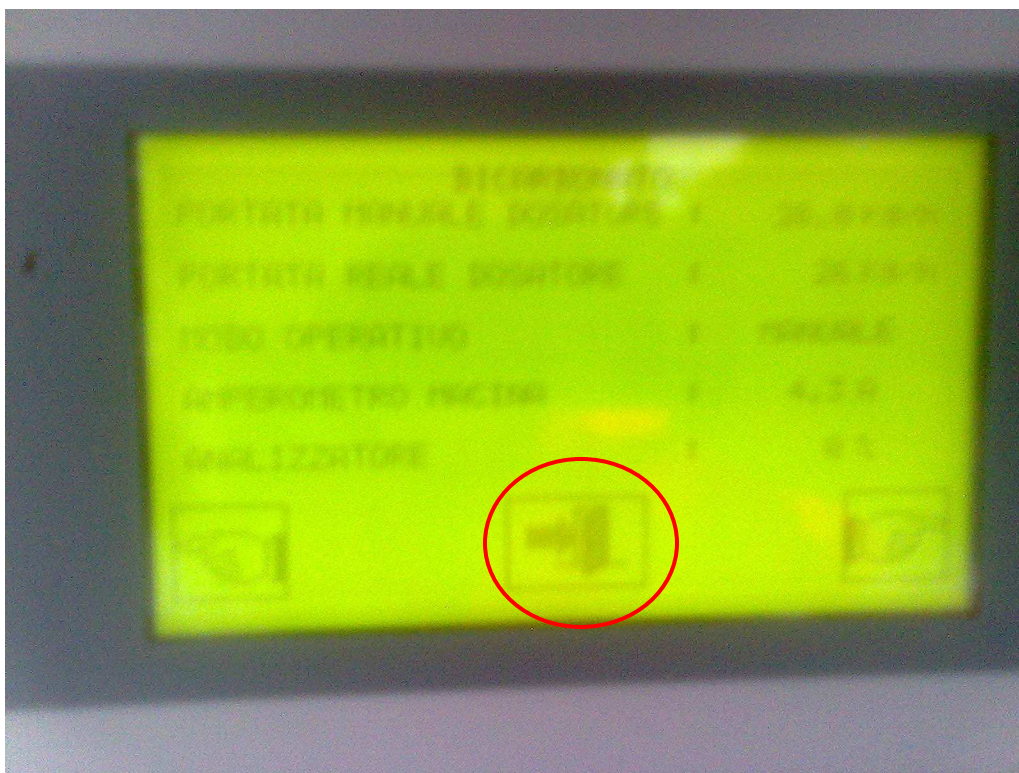
Figure 4 The Keypad where you can enter the new dosing rate

7. By typing in the new value of kg/hr, the dosing rate of Sodium Bicarbonate changes. After typing the new value, press enter, which is the sign with a red circle shown in figure 4.
8. You have successfully changed the dosing rate.
9. To confirm, you can open the panel and look at the value on the left hand side inverter. If the value increased, then you have increased the dosing rate of Sodium Bicarbonate. At 16.8Hz the quantity of Sodium Bicarbonate is 30kg/hr. The more the frequency, the higher the dosing rate.



CONTROLLING SO₂ and HCL IN FLUE GAS

10. When pressing the enter on the numeric key pad, the screen of Bicarbonate returns back. You can see the new value on the left hand side. If the value is correct, press the exit button until you return back to the initial screen.



CONTROLLING SO₂ and HCL IN FLUE GAS

Figure 6 Press exit to return back to initial screen

N.B. Make sure that you change the value of the Sodium Bicarbonate and not of the Activated Carbon. Dosing a lot of Activated Carbon may result in potential fires in the BAG HOUSE FILTER. The dosing rate of Activated Carbon, as seen in figure 7 should remain at 3kg/hr.

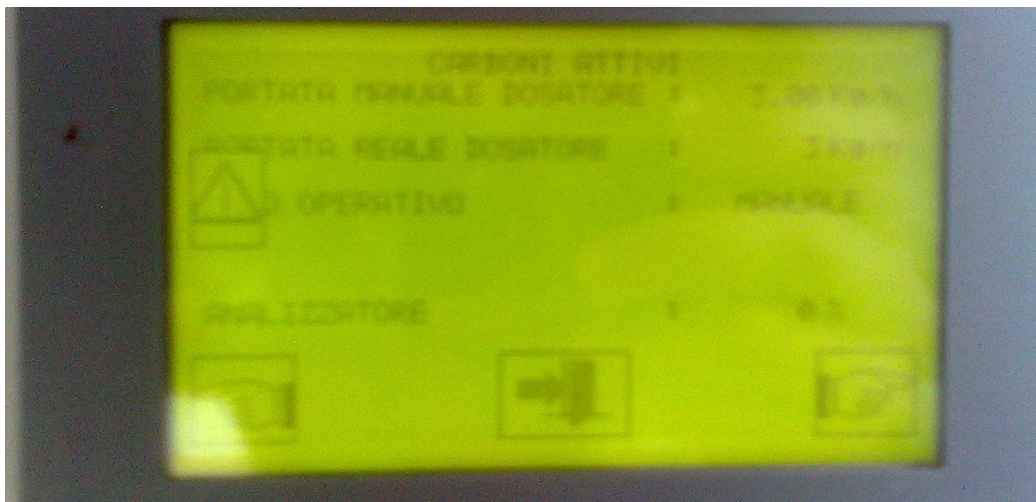


Figure 7 The screen of CARBONI ATTIVI

Annex XV: Waste Checks Analysis

TTF Waste Checks & Analysis

Waste Type	Regulatory Permits & Notes	Declaration	Checks	Lab Analysis
Clinical	ERA Consignment Permit ERA Consignment Note	Declaration form TTF047	Check by Weighbridge Officer at Weighbridge for radioactivity using radioactive analyser. Outcome is documented in form TTF023.	No, given that waste can be contagious.
Pharmaceuticals	ERA Consignment Permit ERA Consignment Note	Declaration form TTF029	Scientist performs check for cytotoxic and cytostatic properties against compiled database and/or Medicines Authority confirmation as applicable. On a monthly basis, Scientist carries out a random spot check confirming that actual pharma delivered is consistent with TTF029. Outcome is documented on form TTF048.	No, given that waste is diverse.
Contaminated Pharmaceutical Packaging	ERA Consignment Permit ERA Consignment Note	Declaration form TTF029	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste and its generation process.	No, given that contamination is typically very small in quantity.
Contaminated Packaging (with oil, petroleum, sludges, etc.)	ERA Consignment Permit ERA Consignment Note	/	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste and its generation process.	No, given that contamination is typically very small in quantity.
Contaminated PPE / Filters	ERA Consignment Permit ERA Consignment Note	/	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste and its generation process.	Lab analysis at WSM's discretion. As necessary, prior to acceptance, WSM will incinerate a sample (approx. x2 25tr / 25kg unit) in the kiln and monitor its impact on emissions.
Oily Rags	ERA Consignment Permit ERA Consignment Note	/	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste and its generation process.	Lab analysis at WSM's discretion. As necessary, prior to acceptance, WSM will incinerate a sample (approx. x2 25tr / 25kg unit) in the kiln and monitor its impact on emissions.
Animal By-Products	VPRD Consignment Permit VPRD Consignment Note	/	As practically visible, Inspectors check bin content to ascertain that no foreign material is present in the waste.	Lab analysis at WSM's discretion.
Fallen Animals	VPRD Consignment Permit VPRD Consignment Note	/	/	No, any tests on fallen animals fall outside WSM's remit.
Pets	/	/	/	No, not deemed necessary given the circumstances.
Confiscated food containing ABPs	VPRD Consignment Permit VPRD Consignment Note	/	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste.	No, given that recommended disposal is incineration.
International Catering Waste	VPRD Consignment Permit VPRD Consignment Note	/	/	No, given that recommended disposal is incineration.

Other Hazardous Waste Example: Chemicals, Solvents, Detergents, etc.	ERA Consignment Permit ERA Consignment Note	Declaration form TTF055 (unless a renewal of previously accepted waste)	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste, its generation process and SDS sheet.	Lab analysis at WSM's discretion. As necessary, prior to acceptance, WSM will incinerate a sample (approx. x2 25tr / 25kg unit) in the kiln and monitor its impact on emissions.
Other Non-hazardous Waste Example: Products, Uniforms, Sensitive Documents, etc.	ERA Consignment Permit ERA Consignment Note	/	At waste enquiry stage, Waste Acceptance Officer asks Waste Producer details on the waste and its generation process.	Lab analysis at WSM's discretion. As necessary, prior to acceptance, WSM will incinerate a sample (approx. x2 25tr / 25kg unit) in the kiln and monitor its impact on emissions.

Notes:

Waste streams above are typical waste streams accepted and treated at TTF.

Annex XVI: EMS Documentation



MCCAA

CERTIFICATE OF REGISTRATION



QUALITY MANAGEMENT SYSTEM

SM EN ISO 9001:2015

This is to certify that:

WasteServ Malta Ltd. - Thermal Treatment Facility

EkoCentre, Latmija Road, MarsaScala MSK 4613

Thermal Treatment Facility, Triq il-Biccerija, Marsa MRS 1123

are holders of **Certificate No: S043** and operate a

QUALITY MANAGEMENT SYSTEM

which complies with the requirements of SM EN ISO 9001:2015

The scope covered by the QUALITY MANAGEMENT SYSTEM

includes:

The operation for the treatment of waste by high temperature incineration including methods for waste acceptance and receipt.

FRANCIS FARRUGIA

DIRECTOR GENERAL

Standards and Metrology Institute



4191

09 April 2013

26 July 2018

25 July 2021

INITIAL REGISTRATION

CURRENT REGISTRATION

EXPIRY DATE

This certificate is the property of Malta Competition and Consumer Affairs Authority (MCCAA) trading as Standards and Metrology Institute (SMI). It shall be returned upon request.

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SMIC(EMS)-F09/REV.3/May2018



MCCAA

CERTIFICATE OF REGISTRATION



ENVIRONMENTAL MANAGEMENT SYSTEM

SM EN ISO 14001:2015

This is to certify that:

WasteServ Malta Ltd. - Thermal Treatment Facility

EkoCentre, Latmija Road, MarsaScala MSK 4613

Thermal Treatment Facility, Triq il-Biccerija, Marsa MRS 1123

are holders of **Certificate No: E009** and operate an

ENVIRONMENTAL MANAGEMENT SYSTEM

which complies with the requirements of SM EN ISO 14001:2015

The scope covered by the ENVIRONMENTAL MANAGEMENT SYSTEM

includes:

The operation for the treatment of waste by high temperature incineration including methods for waste acceptance and receipt.

FRANCIS FARRUGIA
DIRECTOR GENERAL

Standards and Metrology Institute



4191

27 December 2012

26 July 2018

25 July 2021

INITIAL REGISTRATION

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SMIC(EMS)-F09/REV.3/May2018

QUALITY & ENVIRONMENTAL POLICY

Using the Thermal Treatment Facility (TTF), Wasteserv seeks to provide a national service through its rendering and incineration processes. The facility is set up to treat fallen animals, animal by-products, clinical and other hazardous waste streams.

Wasteserv's critical objectives are to achieve and enhance customer satisfaction, protect the environment and provide a reliable yet environmentally aligned waste management services to waste producers, waste carriers and also pet owners.

Through its operations at the TTF, and the various supporting branches, Wasteserv will strive to:

- Comply with IPPC permit IP 0004/07 and all applicable environmental laws and regulations;
- Use the facility (and its resources) efficiently;
- Improve the facility's hazardous waste disposal capacity;
- Monitor and/or control the air pollution, effluent/s and ashes generated;
- Monitor fuel and electricity consumption;
- Implement emergency preparedness measures to minimise and control the risk of fire and spills;
- Attain positive feedback from waste producers, waste carrier and pet owners;

These objectives are reviewed on a quarterly basis and their status is discussed in Management Review Meetings.

To implement this policy we have adopted a management system based on the requirements of ISO 9001:2015 and ISO 14001:2015.

We are committed to continually improve our management system and its effectiveness constantly and repeatedly through established mechanisms. This policy shall be communicated to, and understood by, all personnel within the organisation. We shall also communicate this policy to the public, and to all visitors and contractors at the facility.

This Policy is reviewed periodically to ensure that our focus on customer requirements and environmental preservation is maintained, and that the measures of our promise to our customers are achieved.

Approved by CEO Mr Tonio Montebello



Signature

18 June 2018

Date

Procedure Register



Site: TTF

Date of last update: 02.03.2021

Reference	Document Name	Revision
ADM EP01	EHS Legal Requirements & Compliance	10
ADM EP03	Authority Inspection Report Handling	05
ADM EP04	Aspects and Impacts Procedure	00
TTF EP02	Emergency Preparedness Response Procedure	06
TTF EP03	Disposal of Hazardous Waste Procedure	04
TTF EP04	Raw Gas Monitoring	05
TTF EP05	Monitoring of Ground Emissions	06
TTF EP06	Monitoring of Air Emissions	11
TTF EP08	Monitoring of Waste Water	09
TTF EP09	Testing and Monitoring of Samples	06
TTF EP10	Implementation of Odour Monitoring Programme	07
TTF EP11	Monitoring of Autoclave Operational Parameters	02
TTF QP01	Waste Inquiry Procedure	12
TTF QP03	Waste Storage Procedure	07
TTF QP04	Incineration Procedure	09
TTF QP05	Weighbridge Transaction Documentation Handling	03
TTF QP06	Cytotoxic & Cytostatic Check Procedure	01
TTF QP07	Waste Receipt Procedure at Night	02
TTF SE01	Premises Security Procedure	01

CONTROLLING SO₂ and HCL IN FLUE GAS

HOW TO CONTROL SO₂ AND HCL GENERATION IN FLUE GAS

Two main flue gas components generated from the Incineration process are HCl and SO₂. HCl (or Hydrogen chloride) is a gas at room temperature and is characterized by its very strong acidic character and ability to dissolve in water. When dissolved in water it produces hydrochloric acid (*Actu*).

This gas is generated when organic compounds containing Chlorine are decomposed by high temperatures such as those present in an incineration plant. The amount of HCl generated is related to the concentration of Chlorine in the original waste. Most materials including meats and also tap water contain a certain amount of Chlorine. Others like PCBs (polychlorinated biphenyls) may contain up to 70-75% by weight of chlorine.

If released into the environment HCl will rapidly diffuse in air and will dissolve in any moisture it encounters thus ending up in clouds and coming down again in the form of acid rain which causes acidification of soils rendering it unfertile

SO₂ or Sulfur dioxide is also a gas at room temperature which like HCL dissolves in water giving an acidic solution and is highly corrosive.

This gas is generated during the incineration process from wastes containing sulfur or sulfur containing compounds. The produced SO₂ if not treated causes the same effects of HCL to the environment and in addition is associated with chemical weathering of steel constructions. Sulfur is contained in virtually all materials. Meat proteins contain some 1-2% Sulfur and fossil oils may contain up to 10%.

CONTROLLING SO₂ and HCL IN FLUE GAS

Sodium bicarbonate and HCL/SO₂

To contrast the acidic gases (HCL and SO₂) it is required to use an alkaline substance that will readily react with the acids. Sodium bicarbonate is a very commonly used substance, commonly called baking soda this compound is used to react with lemon juice to reduce its acidity. It is also used in medicine as a treatment for acid reflux from the stomach to remove that burning sensation.

In incineration it is used to neutralize directly the SO₂ and HCL and other acidic gases generated by the process. The solid is pumped through the dosing equipment and a cloud of dust is mixed to the incoming gases and given enough time it reacts producing CO₂ and harmless salts which end up in the fly ash. The load of acids it can take is limited thus the amount is to be calibrated with the wastes being burned. When in normal operating conditions 15-25kg/hr would be able to neutralize all the acid gases produced but in special cases extra bicarbonate is required, thus a rapid increase in Dosing is required

When SO₂ and HCL levels start increasing, the Head of Shift should do the following actions:

1. From Board M located adjacent to the Sodium Bicarbonate and Activated Carbon dosing equipment, press on the touch screen installed on the front panel of the electrical board, as shown in figure 1.

CONTROLLING SO₂ and HCL IN FLUE GAS



Figure 1 The touch screen panel on board M

2. When touching the screen, a second screen appears showing four icons as shown in figure 2. The four icons read the following:
- a. **Tempi**
 - b. **Setup**
 - c. **Velocita Stato Motori**
 - d. Exit (the icon with the door)



CONTROLLING SO₂ and HCL IN FLUE GAS

Figure 2 Screen showing the 4 icons, including the "Velocita Stato Motori"

3. The Head of Shift should touch lightly the icon reading **Velocita Stato Motori** as shown in figure 2. No password is required to change this value.

4. The next screen that appears is that of **Sodium Bicarbonate**.

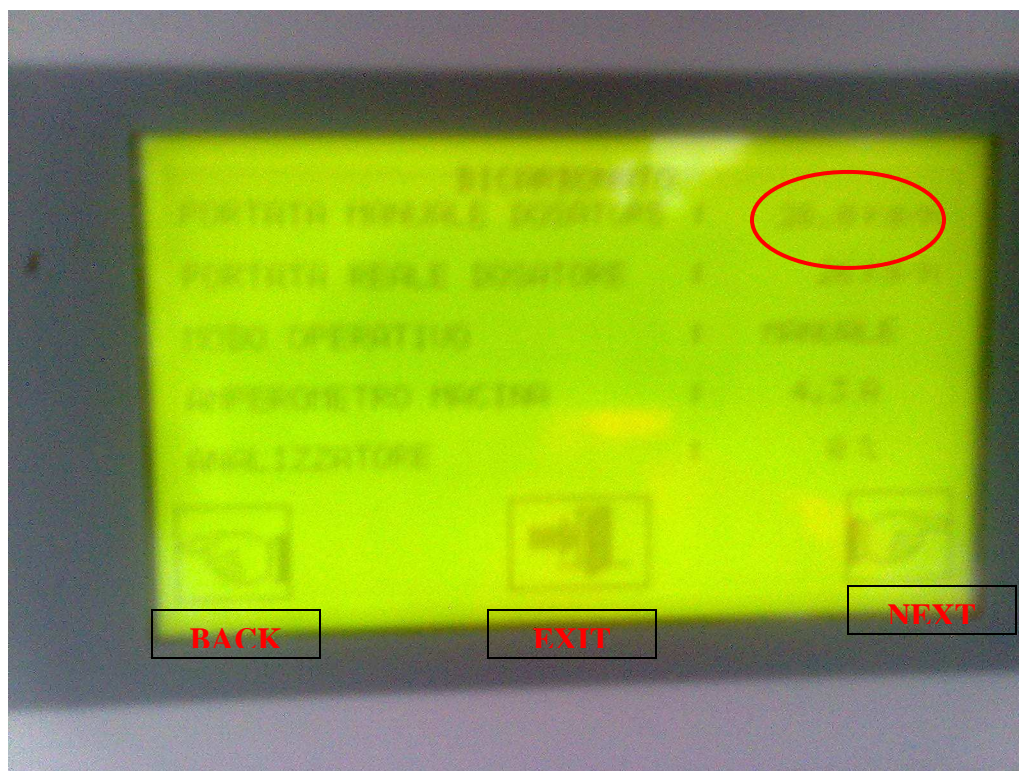
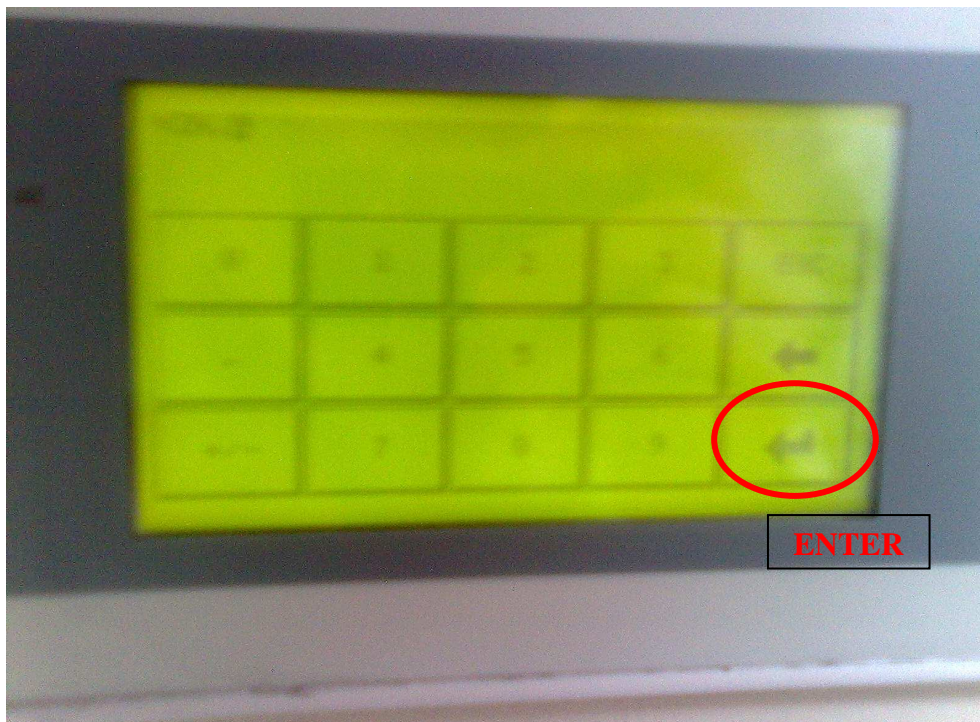


Figure 3 The Bicarbonate Dosing Rate Screen

CONTROLLING SO₂ and HCL IN FLUE GAS

5. The Head of Shift should touch lightly the first value on the right hand side adjacent to **"portata manuale dosatore"**.

6. Another screen appears immediately with an electronic numeric keyboard.



CONTROLLING SO₂ and HCL IN FLUE GAS

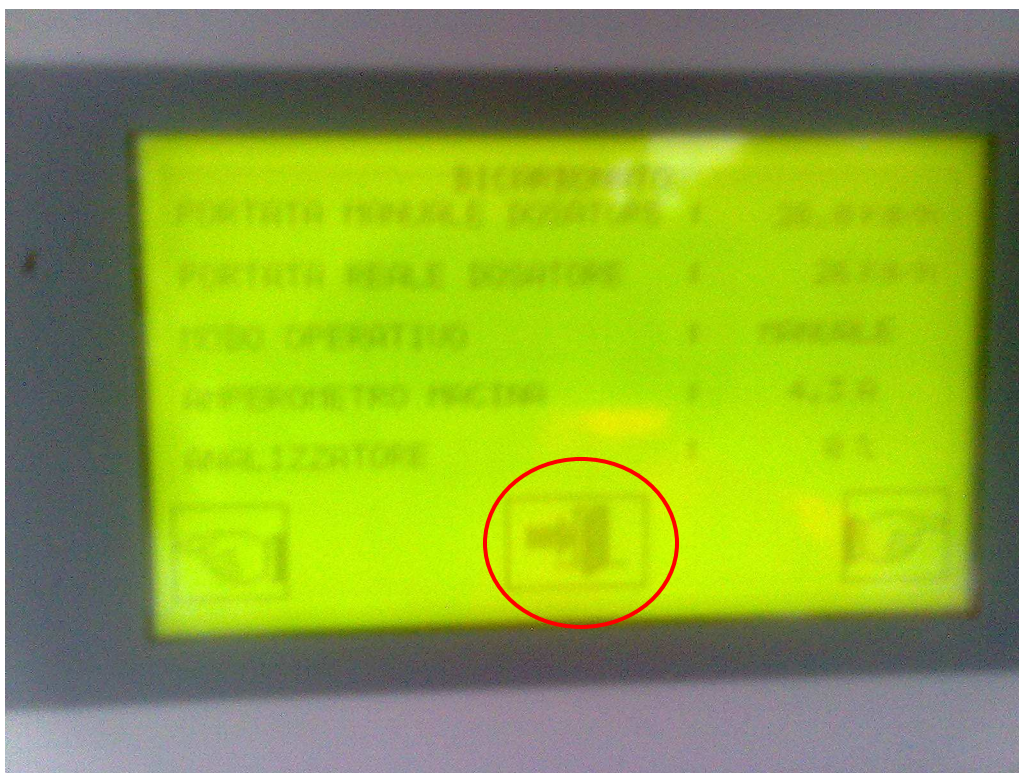
Figure 4 The Keypad where you can enter the new dosing rate

7. By typing in the new value of kg/hr, the dosing rate of Sodium Bicarbonate changes. After typing the new value, press enter, which is the sign with a red circle shown in figure 4.
8. You have successfully changed the dosing rate.
9. To confirm, you can open the panel and look at the value on the left hand side inverter. If the value increased, then you have increased the dosing rate of Sodium Bicarbonate. At 16.8Hz the quantity of Sodium Bicarbonate is 30kg/hr. The more the frequency, the higher the dosing rate.



CONTROLLING SO₂ and HCL IN FLUE GAS

10. When pressing the enter on the numeric key pad, the screen of Bicarbonate returns back. You can see the new value on the left hand side. If the value is correct, press the exit button until you return back to the initial screen.



CONTROLLING SO₂ and HCL IN FLUE GAS

Figure 6 Press exit to return back to initial screen

N.B. Make sure that you change the value of the Sodium Bicarbonate and not of the Activated Carbon. Dosing a lot of Activated Carbon may result in potential fires in the BAG HOUSE FILTER. The dosing rate of Activated Carbon, as seen in figure 7 should remain at 3kg/hr.

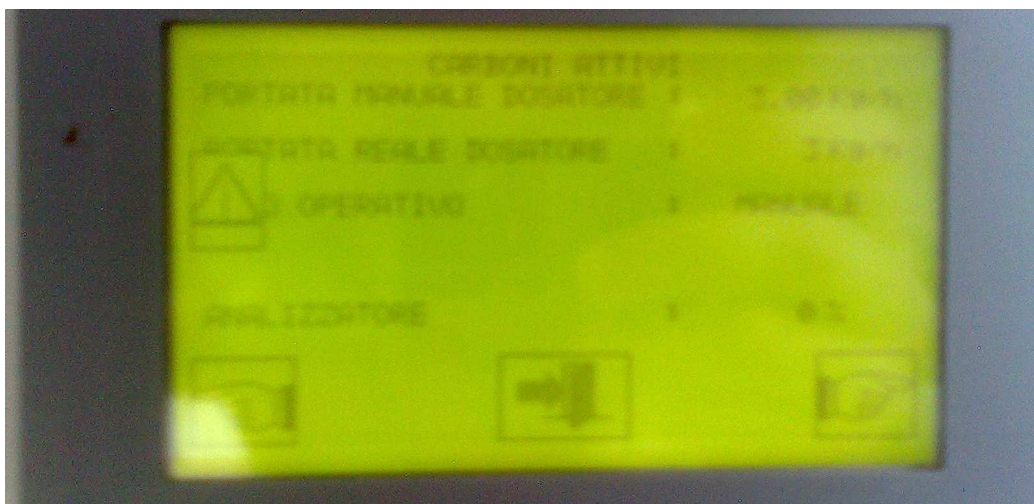



Figure 7 The screen of CARBONI ATTIVI

		ANALYSIS OF PLANT WATER	
Prepared by:	Natalia Mangion	Approved by:	Darren Cutajar
Issue Date:	22/07/2013	Updated on:	28/03/2017

INTRODUCTION:

Every Steam Boiler system requires a proper Boiler Water Treatment Program with regularly test the water to analyze a number of parameters, adequate regulated blow downs, correct maintenance, periodic safety checks and periodic inspection follow-up. All of these are necessary for long life, efficient boiler service and imperative as it avoids corrosion and malfunction.

OBJECT:

Degasser, Demineralized and Boiler water taken from waterside preboiler section, boiler, steam and condensate pipes accordingly have to be tested on a regular basis, once per week. After each shut down the first sample has to be collected only after 24 hours of Plant running to settle the whole system.

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2.	Determination of Total Hardness	2
3.	Determination of Total Alkalinity	3
4.	Determination of Sulphite	4
5.	Determination of Iron	5
6.	Determination of Free Chlorine	6

Determination of pH, Conductivity and TDS


Required:

- HI 4521 pH/TDS Bench Meters
- Stirring rod, glass, beaker 100 mL high form, wash bottle

Procedure:

1. To measure the pH

1. Press button **MODE** and then **pH** to select *pH Measure* mode.
2. Select the direct reading mode.
3. Submerge the electrode tip and the temperature probe approximately 4 cm into the sample to be tested.
4. Allow time for the electrode to stabilize. The measured pH value will be displayed on the LCD, together with a short GLP information or "Default Calibration" message if no pH calibration was performed.

		ANALYSIS OF PLANT WATER	
Prepared by: Natalia Mangion		Approved by: Darren Cutajar	
Issue Date: 22/07/2013		Updated on: 28/03/2017	

II. To measure the Conductivity

1. Press **MODE** and **COND** to select conductivity measure mode.
2. Select the direct reading mode.
3. Submerge the conductivity probe and tap it repeatedly to remove any air bubbles that may be trapped inside the sleeve.
4. Allow time for the reading to stabilize.
5. The measured conductivity value will be displayed on the LCD.
6. Select the direct reading mode.
7. Submerge the electrode tip and the temperature probe approximately 4 cm into the sample to be tested.
8. Allow time for the electrode to stabilize. The measured pH value will be displayed on the LCD.

III. To measure the TDS


1. Press **MODE** and **TDS** to select TDS measure mode.
2. Select the direct reading mode.
3. Submerge the conductivity probe and tap it repeatedly to remove any air bubbles that may be trapped inside the sleeve.
4. Allow time for the reading to stabilize.
5. The measured TDS value will be displayed on the LCD.
6. Select the direct reading mode.
7. Submerge the electrode tip and the temperature probe approximately 4 cm into the sample to be tested.
8. Allow time for the electrode to stabilize. The measured TDS value will be displayed on the LCD.

Facilitation: In case pH, Conductivity and TDS out of the Limit the draining of the Boiler Water has to be provided.

Determination of Total Hardness

Required:

- DR/890 COLORIMETER
- Alkali Solution for Calcium and Magnesium Test (Cat. 22417-32)
- Calcium and Magnesium Indicator Solution (Cat. 22418-32)
- EDTA Solution, 1M (Cat. 22419-26)
- EDTA Solution (Cat. 22297-26)
- 100-mL graduated mixing cylinder
- 1.0-mL measuring dropper

		ANALYSIS OF PLANT WATER	
Prepared by: Natalia Mangion		Approved by: Darren Cutajar	
Issue Date: 22/07/2013		Updated on: 28/03/2017	

Procedure:

1. Enter the stored program number for Hardness – **30**.

Note: For alternate forms (Mg, MgCO₃), press the **CONC** key.

2. Pour 100 mL of sample into a 100-mL graduated mixing cylinder. The sample temperature should be 21 - 29°C.
3. Add 1.0 mL of Calcium and Magnesium Indicator Solution using a 1.0-mL measuring dropper. Stopper. Invert several times to mix.
4. Add 1.0 mL of Alkali Solution for Calcium and Magnesium Test using a 1.0-mL measuring dropper. Stopper. Invert several times to mix.

Note: If the sample turns read after adding Alkali Solution, dilute the sample 1:1 and repeat analysis.

5. Pour 10mL of the solution into each of three sample cells.
6. Add one drop of 1M EDTA Solution to one sell (**the Blank**). Swirl to mix.
7. Add one drop of EGTA to another cell (**the Prepared Sample**). Swirl to mix.
8. Place the blank into the cell holder. Cover the sample cell with the instrument cap. Press **ZERO** and the display will show: 0.00 mg/L CaCO₃.
9. Place the prepared sample into the cell holder. Cover the sample cell with the instrument cap. Press **READ** and then the result in mg/L magnesium hardness (as CaCO₃) will be displayed.
10. Without removing the cell, enter the program number - **29**. Press **ZERO**. The display will show: 0.00 mg/L CaCO₃.
11. Place the third sample cell into the cell holder and press **READ**. The result in mg/L calcium hardness (as CaCO₃) will be displayed.

Calculation of results:


$$\begin{array}{llll} \text{Total Hardness} = & \text{Calcium Hardness} & + & \text{Magnesium Hardness} \\ (\text{mg/L as CaCO}_3) & (\text{mg/L as CaCO}_3) & & (\text{mg/L as CaCO}_3) \end{array}$$

Facilitation: In case Hardness is out of the Limit the draining of the Boiler Water has to be provided.

Determination of Total Alkalinity

Required:

- HI 83200 Photometer

		ANALYSIS OF PLANT WATER	
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- HI 93755-0 Alkalinity Indicator
- Cuvette
- 1.0 mL pipet

Procedure:

1. Select the Alkalinity method.
2. Fill the cuvette with 10 ml of no reacted sample up to the mark and replace the cap.
3. Place the cuvette into the holder, close lid and press the **ZERO** key. The display will show “-0-“the meter is zeroed and ready for measurement.
4. Remove the cuvette and add 1 mL of HI 93755-0 Alkalinity and invert 5 times.
5. Reinsert the cuvette into the instrument.
6. Press **READ** to start the reading. The instrument displays in mg/L of Alkalinity (CaCO₃).

Facilitation: In case Total Alkalinity out of the Limit the draining of the Boiler Water has to be provided.

Determination of Sulphite

Sampling: Minimum volume 100ml. Holding time: let it cool down to the room temperature

Required:

- Sulfamic Acid Solution
- EDTA Reagent
- Sulphuric Acid Solution
- Starch Indicator
- HI 3822-0 Reagent Titrant Solution
- 2 calibrated vessels (20 & 50 ml), 1 calibrated syringe with tip.

Procedure:

I. HIGH RANGE – 0 to 200 ml/L Na₂ SO₃

1. Remove the cap from the small plastic vessel and rinse it with water sample. Fill to the 5 ml mark and replace the cap.
2. Add 4 drops each of Sulfamic Acid Solution and EDTA Reagent through the cap port and mix by carefully swirling the vessel in tight circles.
3. Add 2 drops of Sulphuric Acid Solution through the cap port and mix as described before.

4. Add 1 drop of Starch Indicator through the cap port and mix.
5. Take the titration syringe and push the plunger completely into the syringe. Insert tip into HI 3822-0 Reagent Titrant Solution and pull the plunger out until the lower edge of the plunger seal is on the 0 ml mark of the syringe.
6. Place the syringe tip into the cap part of the plastic vessel and slowly add the titration solution dropwise, swirling to mix after each drop. Continue adding titration solution until the solution in the vessel changed from colorless to blue.
7. Read off milliliters of titration solution from the syringe scale and multiply by 200 to obtain mg/L (ppm) sodium sulfite.

II. LOW RANGE – 0 to 20 ml/L Na₂ SO₃

1. If results are lower than 20mg/L, the precision of the test can be improved as follows.
2. Remove the cap from the large plastic vessel. Rinse the vessel with the water sample, fill to the 50 mL mark and replace the cap.
3. Proceed with the test as described before and multiply the values on the syringe scale by 20 to obtain mg/L sodium sulfite in the sample.

Facilitation: In case the result of Sulphite out of its limit use BT 1040/BT 21OT treatment prepared in the ratio Water 50%, BT 1040 30% and BT 21OT 20%.

Determination of Iron


Required:

- HI 83200 Photometer
- HI 93721-0 Reagent
- beaker 100 mL high form

Sampling: Minimum volume 100ml. Holding time: let it cool down to the room temperature

Procedure:

1. Select the Iron HR method.
2. Fill the cuvette with 10 ml of no reacted sample up to the mark and replace the cap.
3. Place the cuvette into the holder, close lid and press the **ZERO** key. The display will show “-0-” the meter is zeroed and ready for measurement.

		ANALYSIS OF PLANT WATER	
Prepared by: Natalia Mangion		Approved by: Darren Cutajar	
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4. Remove the cuvette and add the content of one packet of HI 93721-0 reagent. Replace the cap and shake until dissolution is complete.
5. Reinsert the cuvette into the instrument.
6. Press Timer and the display will show the countdown prior to the measurement or, alternatively, wait for 3 minutes and press **READ**. When the timer ends the meter will perform the reading. The instrument displays concentration in mg/L of Iron

Facilitation: In case the result of Iron out of its limit Boiler Water has to be provided.

Determination of Free Chlorine

Required:

- HI 83200 Photometer
- HI 93701A Indicator
- HI 93701B Buffer

Sampling: Minimum volume 100ml. Holding time: let it cool down to the room temperature

Procedure:

7. Select the Free Chlorine method using the procedure described in the Method Selection section.
8. Fill the cuvette with 10 ml of unreacted sample up to the mark and replace the cap.
9. Place the cuvette into the holder and close lid.
10. Press the **ZERO** key. The display will show “-0-”the meter is zeroed and ready for measurement.
11. To on empty cuvette to add 3 drops of HI 93701A indicator and 3 drops of HI 93701B Buffer. Swirl gently to mix, and immediately add 10 mL of unreacted sample. Replace the cap and shake gently again.
12. Reinsert the cuvette into the instrument.

Press **READ** to start the reading. The instrument displays the result in mg/L of Free Chlorine

Autoclave/TTF Wastewater

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1 INTRODUCTION

The Wastewater produced at the Thermal Treatment Facility and Autoclave in Marsa, in accordance to the Integrated Pollution Prevention and Control Regulation, paragraph 3.2 Wastewater, has to be analysed before being returned to the environment. Wastewater generation undergoes several stages which are the following:

- 1) Wastewater from the TTF Shredder Room and from bin washing along with Wastewater from the Autoclave Processing Plant end up in a common Waste Water Reservoir (V01) in the Wastewater Treatment Plant (WWTP) near the Autoclave. The following is a schematic representation of all reservoirs in the WWTP.

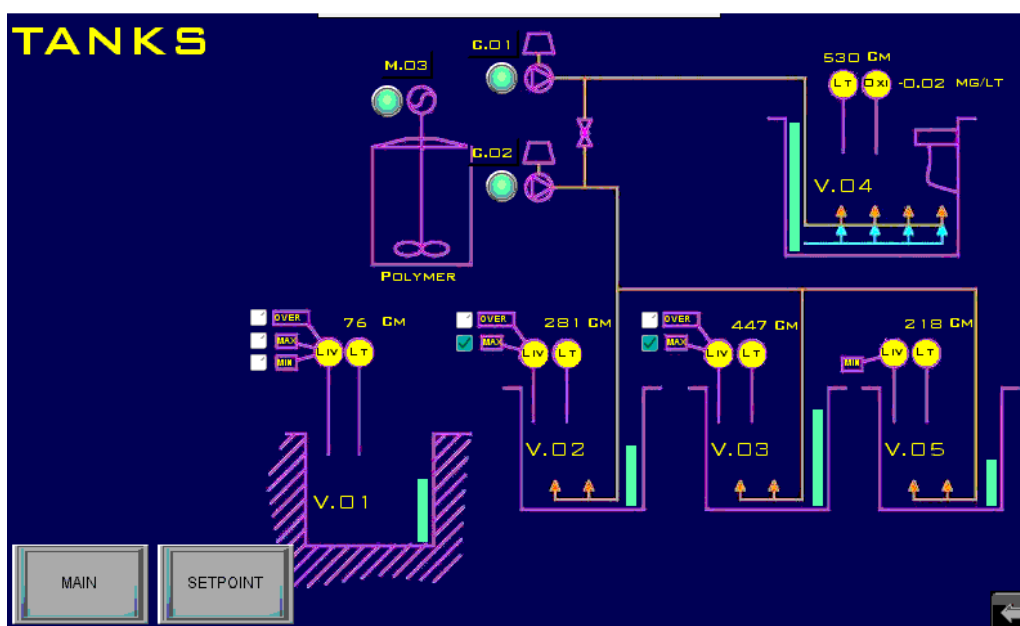


Figure 1 - Wastewater reservoirs in the WWTP

- 2) Wastewater from V01 undergoes mechanical filtration to remove large particles and ends up in another reservoir called R-Grid Wastewater Reservoir (V02).
- 3) Subsequently, wastewater undergoes chemical treatment during which sodium hydroxide (to increase the pH), a flocculating polymer (to flocculate and aggregate materials) and polyaluminium chloride are added so that suspended particles float and rise to the surface before being skimmed off by a mechanical skimmer. This sludge which rises to the top ends up in a reservoir called Sludge Reservoir (V05). Meanwhile, the chemically treated water ends up in a reservoir called U-DAF Water Reservoir (V03).
- 4) Finally, water from the U-DAF enters the SBR tank (V04) where biological treatment takes place. In this tank, bacteria carry out two processes:
 - a. A nitrification/oxidation process which involves the conversion of organic-nitrogen compounds and ammonia to nitrates and nitrites

- b. A denitrification process which involves the conversion of nitrates and nitrites to atmospheric nitrogen

Note that this process occurs in batches (i.e. it is not continuous) and takes about 6.5 hours to complete. After each batch-cycle, water is allowed to settle so that bacteria move to the bottom and clarified water (2nd class wastewater) forms a supernatant on top. In truth, on top of the supernatant another type of sludge settles and gets skimmed off and transferred to V05. A certain amount of the 2nd class wastewater is transferred to a Final Wastewater Reservoir which upon reaching a certain capacity empties into the drainage system.

2 SAMPLING, STORAGE AND PREPARATION FOR TESTS

A 1-Litre-sample of Raw Wastewater is collected from the Autoclave's R-Grid Waste Water Reservoir (V02) once per week, whilst 1-Litre samples are collected on alternate days when the SBR cycle finishes and starts to empty water into the Final Waste Water Reservoir. During the days when the SBR tank is always in standby denitrification/nitrification mode, a sample is taken directly from the SBR Tank (V04) and allowed to settle for 30 minutes before analysing the supernatant on top.

NOTE: In order to find out the stage of the SBR cycle one needs to access the small monitor found in the autoclave control room. From the start screen one needs to press MAIN and then click on SBR. The stage at which the SBR cycle is can be located at the top-right corner along with the time elapsed since the start of that cycle

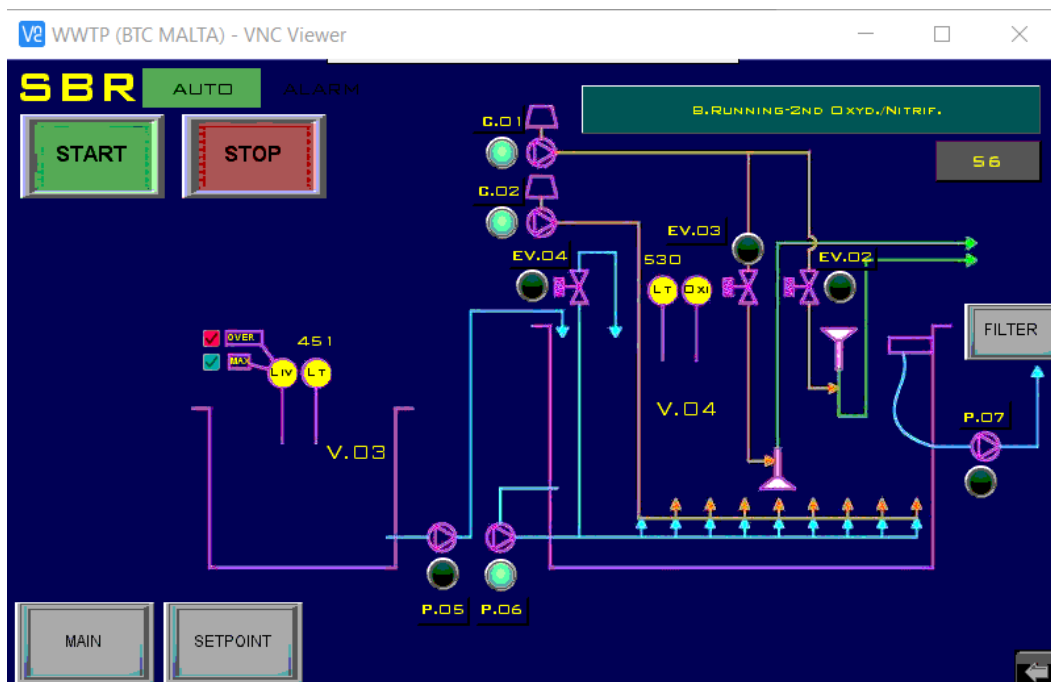


Figure 2 - SBR cycle

By pressing **SETPOINT** one can understand exactly what are the stages that follow and hence one can calculate how much time is left before water gets discharged.

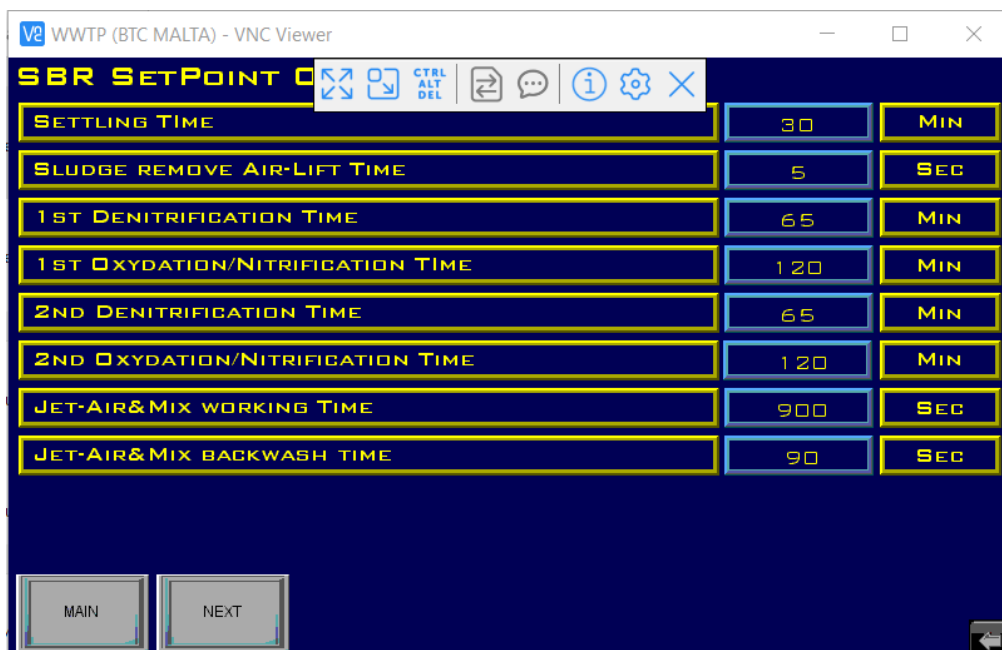


Figure 3 - Stages of the SBR cycle

If the samples are not going to be analysed immediately, the samples are stored at specific temperatures (depending on test) for up to a specific number of days (depending on test) in a stoppered glass or plastic bottle (free of organic contaminants) immediately after collection. However, it is highly recommended to analyse the sample immediately after collection. **Biologically active samples must be tested as soon as possible and within 24 hours of completion of sample collection.**

3 DETERMINATION OF pH AND TEMPERATURE

3.1 Required

- HANNA HI 4521 Bench Meter
- Beaker, 100mL high form
- Wash Bottle
- Deionised water (DI water)

3.2 Procedure for the HANNA HI 4521 Bench Meter

1. Press buttons **MODE** and then **pH** to select pH Measure mode.
2. Select the **direct reading mode**.
3. Submerge the pH electrode tip and the temperature probe approximately 4 cm into the sample to be tested.
4. Allow time for the pH value to reach a constant value and take the reading.

5. The measured value for sample temperature (in °C) will be also displayed on the LCD screen.
6. After measurement, clean the electrodes with DI water and dry carefully with a tissue.

4 DETERMINATION OF TOTAL SUSPENDED SOLIDS (TSS) LEVELS (0 – 750 mg/L)



Suspended Solids
(Photometric Method)

4.1 Required

- HACH DR/890 COLORIMETER
- 2 x 25 mL Graduated Sample Cells
- Deionised water (DI water)
- Blender
- Beaker, 600 mL

4.2 Procedure

1. Switch on the Colorimeter.
2. Press **PRGM** and enter the stored program number **94**.
3. Blend 500 mL of sample in a blender at high speed for about 2 minutes.
4. Fill a sample cell with 25 mL of deionized water (the **Blank**).
5. Place the blank in the cell holder. Tightly cover the sample cell with the instrument cap. Press: **ZERO**.
6. Stir the blended sample thoroughly and immediately pour 25 mL of the blended sample into a sample cell (the **Prepared Sample**) and place it into the cell holder.
7. Tightly cover the sample cell with the instrument cap. Press: **READ** and get the result in mg/L SuSld.

NOTE: Remove gas bubbles in the water by swirling or tapping the bottom of the sample cell on a flat surface.

NOTE: If the screen reads *LIMIT* repeat the test with diluted sample using DI water as the diluent.

NOTE: The estimated detection limit for program 94 is 22.1 mg/L Suspended Solids.

5 DETERMINATION OF SETTLEABLE SOLIDS LEVELS

5.1 Required

- Imhoff cone
- Stirring rod
- Rack for holding Imhoff cone

- Timer

5.2 Procedure

1. Fill an Imhoff cone to the one-litre mark with a well-mixed sample.
2. Allow sample to settle in the Imhoff cone for 45 minutes.
3. Gently stir the sample with a glass rod to release the suspended matter clinging to the sides of the Imhoff cone.
4. Let sample settle for an additional 15 minutes.
5. After the stipulated period, record the volume of Settleable solids (in millilitres) in the Imhoff cone.

NOTE: Do not include any floating solids or any voids in the settled solids as Settleable matter.

6 DETERMINATION OF CHEMICAL OXYGEN DEMAND LEVEL (COD) (0 – 15,000 mg/L)

Principle: Oxidizable organic compounds react and reduce the dichromate ion ($\text{Cr}_2\text{O}_7^{2-}$) present in the reagent vial to green chromic ion (Cr^{3+}). The strength of this green colour gets converted to a concentration value by the colorimeter.



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10.pdf

6.1 Required

- HACH DR/890 COLORIMETER
- Thermostat Spectroquant TR 420
- Blender
- Beaker, 600 mL
- 2 x Graduated Pipettes (0.00 – 1.00 mL)
- 2 x COD Digestion Reagent Vials (0 – 15,000) (Cat. 2415951)
- Concentrated sulfuric acid (for storage)

6.2 Procedure

NOTE: To preserve samples adjust the pH to less than 2 with concentrated sulfuric acid and then keep stored at $2 - 6^\circ\text{C}$ for a maximum of 28 days. The final result should be corrected to account for the dilution caused by volume additions of acid.

1. Homogenize 100 mL of sample for **2 minutes**.
2. Pour the blended sample into a 250 mL beaker. Stir with a magnetic stirrer while withdrawing a sample aliquot.
3. Turn on the thermostat and heat to 150°C by choosing program 7.

4. **Sample** preparation: Hold one COD Digestion Reagent Vial at a 45-degree angle and (after removing cap) pipette 0.2 mL of sample into the vial.
5. **Blank** preparation: Hold another vial at a 45-degree angle and pipette 0.2 mL of deionized water.
6. Screw the caps on tightly, rinse the vials with water and wipe with a clean paper towel.
7. Hold the vials by the cap, over a sink. Invert gently several times to mix. The vials get very hot during mixing.
8. Put the vials for 2 hours in the preheated thermostat. Close the lid.
9. Turn the thermostat off. Wait about 20 minutes for the vials to cool to 120°C or less.
10. Invert each vial several times while still warm. Place the vials into a rack and cool them to room temperature for final measurement.
11. Switch on the colorimeter and insert the COD/TNT adapter into the cell holder by rotating the adapter until it drops into place. Then push down to fully insert it.
12. Enter the stored program number **17**.
13. Clean the outside of the vials with a towel to clean and remove fingerprints or other marks.
14. Place the blank in the adapter; tightly cover the sample with the instrument cap and press **ZERO**.
15. Prepare the sample in the same way; press **READ** and get the result in mg/L COD.
16. If the COD value is close to 15,000 mg/L the analysis should be repeated using a more dilute sample.
17. Since High Range Plus COD digestion reagent vials are used, the result must be multiplied by 10.

NOTE: *The reagent mixture in the vial is light-sensitive. Keep unused vials in the opaque shipping container.*

7 DETERMINATION OF TOTAL KJELDAHL NITROGEN LEVELS

7.1 Required

- HACH DR 1900 SPECTROPHOTOMETER
- HACH LCK 338 LATON Total Nitrogen (20 - 100 mg/L TN)
 - Solution A
 - Reagent B tablets
 - Test Cuvette
 - Solution D
- HACH LCK 339 Nitrate (0.23 - 13.5 mg/L NO₃⁻-N, 1 – 60 mg/L NO₃⁻)
 - Test Cuvette
 - Solution A
- HACH LCK 341 Nitrite (0.015 – 0.6 mg/L NO₂⁻-N, 0.05 – 2.0 mg/L NO₂⁻)
 - Test Cuvette with DoziCap Zip Cap

- Thermostat Spectroquant TR 420
- Graduated Pipettes (0.00 – 1.00 mL and 0.0 – 5.0 mL) or Automatic Pipettes with the required tips
- 20 mL Reaction Tube
- 5 N Sodium Hydroxide and 2.5 N Hydrochloric Acid (to increase/decrease pH accordingly). Note that concentrated hydrochloric acid has a normality of 12 N.

7.2 Procedure

7.2.1 Step 1: Determining the Total Nitrogen (TN) content (20 – 100 mg/L)



Working-Procedure-L
CK-338-LATON.pdf

Principle: An alkaline persulfate (SO_5^{2-}) solution is added to a small sample of the waste water in order to convert nitrogen compounds (nitro compounds, amino compounds, amino acids, proteins) present in the waste water to nitrate(V) ions after heating for 30 minutes at 120 °C. Sodium metabisulfite ($\text{Na}_2\text{S}_2\text{O}_5$) is then added to eliminate halogen oxide interferences. Finally, chromotropic acid is added so that the formed nitrate(V) ions react with it in highly acidic conditions to form a yellow complex. The intensity of this complex gets converted to a numerical concentration value by the spectrophotometer.

1. Let the sample temperature equilibrate to room temperature before analysis and adjust the pH (using sodium hydroxide or hydrochloric acid) so that it is between 3 and 12. Note that you should correct the final test result by considering the dilution caused by the volume additions.
2. Turn on the thermostat and preheat to 120°C (programme 2).
3. Add:
 - a. 0.2 mL of sample wastewater,
 - b. 2.3 mL of Solution A (from test kit LCK 338 LATON Total Nitrogen) and
 - c. 1 Reagent B tablet (from test kit LCK 338 LATON Total Nitrogen)

in quick succession to a dry 20-mL reaction tube (from test kit **LCK 338 LATON Total Nitrogen**). Screw the cap on the reaction tube immediately. **Do not invert.**

4. Insert the reaction tube in the preheated thermostat. Make sure that the cap is tight or else solvent evaporation takes place. Close the lid.
5. Keep the reaction tube in the thermostat for **30 minutes**.
6. Then, carefully remove the reaction tube from the thermostat. Let the temperature of the reaction tube decrease to room temperature.
7. Make sure that the cap is still tight and invert the reaction tube several times in order to mix the contents well.
8. Use a pipette to transfer 0.5 mL of the digested sample from the 20-mL reaction tube to a test vial.
9. Use a pipette to add 0.2 mL of Solution D to the test vial. Quickly tighten the cap on the vial and invert until completely mixed.

NOTE: This can be confirmed because no more streaks are visible (streaks are created due to the different liquid refraction indexes).

10. Start the reaction time of 15 minutes.
11. After **15 minutes**, clean the vial with a wet cloth and then with a dry one before inserting it into the cell holder.
12. Switch on the spectrophotometer. Press the **TOOL** button, choose **PROGRAMS**, select **LCK/TNTplus methods**, scroll up/down, and select the test **LCK 338** by pressing **START**. Push **READ** to get a value of mg/L TN.

NOTE: If +++ appears on screen, the test should be repeated on a diluted sample. A dilution factor of 10 is typical.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Cl^- (>5000 mg/L)
- COD (>2500 mg/L)

7.3 Step 2: Determining the Nitrate-N (NO_3^- -N) content (0.23 – 13.50 mg/L)

Principle: Nitrate(V) ions react with 2,6-dimethylphenol (contained in vial) in strong acidic conditions to form 6-nitro-2,4-xyleneol which is yellow in colour and its concentration is detected colorimetrically by the spectrophotometer.



Nitrate method.pdf

NOTE: If +++ appears on screen, the test should be repeated on a diluted sample. A dilution factor of 10 is typical.

NOTE: Not more than 3 hours should elapse between sampling time and analysis.

1. Use a pipette to add 1.0 mL of sample to the test vial (from test kit **LCK 339 Nitrate**).
2. Use a pipette to add 0.2 mL of Solution A (from test kit **LCK 339 Nitrate**) to the test vial.
3. Quickly tighten the cap on the vial and invert until completely mixed and no more streaks are visible.
4. After **15 minutes**, clean the vial with a wet cloth and then with a dry one before inserting it into the cell holder.
5. Go to **LCK/TNTplus methods** and select the test **LCK 339**. Push **READ** to get a value of mg/L NO_3^- -N.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- K^+ , Na^+ , Cl^- (> 500 mg/L);
- $Ag(I)$ (> 100 mg/L);
- $Pb(II)$, $Zn(II)$, $Ni(II)$, $Fe(III)$, $Cd(II)$, $Sn(II)$, $Ca(II)$, $Cu(II)$ (> 50 mg/L);
- $Co(II)$, $Fe(II)$ (>10 mg/L);
- $Cr(VI)$ (> 5 mg/L)
- NO_2^- (> 2 mg/L)

Possible solutions to remove interferences:

- Remove nitrite by addition of amidosulfonic acid
- Remove chloride by addition of silver sulfate(VI)

7.4 Step 3: Determining the Nitrite-N (NO_2^- -N) content (0.015 – 0.6 mg/L)

NOTE: If +++ appears on screen, the test should be repeated on a diluted sample. A dilution factor of 10 is typical.



Nitrite method.pdf

NOTE: Not more than 3 hours should elapse between sampling time and analysis.

1. Carefully remove the foil from the screwed-on DosiCap Zip cap, then unscrew the cap from the test vial (from test kit **LCK 341 Nitrite**).
2. Use a pipette to add 2.0 mL of sample to the test vial. Immediately continue to next step.
3. Screw the DosiCap Zip cap back onto the test vial so that the reagent side faces the inside of the vial. Tighten the cap on the vial.
4. Shake the vial firmly until the contents in the cap dissolve completely.
5. After **10 minutes**, invert a few times more, then clean the vial with a wet cloth followed by a dry one and insert into cell holder.
6. Switch on the spectrophotometer. Go to **LCK/TNTplus methods** and select the test **LCK 341**. Push **READ** to get a value in mg/L NO_2^- -N.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded: Cl^- , SO_4^{2-} (>2000 mg/L); K^+ , NO_3^- (>1000 mg/L); NH_4^+ , PO_4^{3-} , Ca^{2+} (500 mg/L); Mg^{2+} (>100 mg/L), $Cr(III)$ (>50 mg/L); $Co(II)$, $Zn(II)$, $Cd(II)$, $Mn(II)$, $Hg(II)$ (>25 mg/L); $Ni(II)$ (>12 mg/L), $Ag(I)$, $Fe(II)$ (>10 mg/L), $Sn(IV)$, $Fe(III)$ (> 5 mg/L).

7.5 Calculation and expression of results

The value of total Kjeldahl Nitrogen is given by:

$$\text{Total Kjeldahl Nitrogen} = \text{Total Nitrogen (mg/L)} - [\text{Nitrate-N (mg/L)} + \text{Nitrite-N (mg/L)}]$$

8 DETERMINATION OF SULFIDE LEVELS (0.00 - 0.70 mg/L S²⁻)

Principle: Hydrogen sulfide and acid-soluble metal sulfides react with *N,N*-dimethyl-*p*-phenylenediamine oxalate to form methylene blue. The intensity of the colour gets converted to a concentration value by the colorimeter.



Sulfide (USEPA)
Methylene Blue Methc

8.1 Required

- HACH DR/890 COLORIMETER
- Sulfide 1 Reagent (Cat. 1816-32)
- Sulfide 2 Reagent (Cat. 1817-32)
- Deionised water (DI water)
- 1 mL Pipette or Automatic Pipette with appropriate Tip.
- 2 x 25 mL Graduated Sample Cells

8.2 Procedure:

NOTE: Sample should be analyzed immediately without leaving it exposed to air to prevent sulfide oxidation. Avoid agitation and filter sample to remove as much turbidity as possible.

1. Switch on the colorimeter. Press. **PRGM**. Enter the stored program number for sulfide – **93**.
2. **Sample** preparation: fill a clean sample cell with 25 mL of sample
3. **Blank** preparation: fill a clean sample cell with 25 mL of DI water.
4. Add 1.0 mL of Sulfide 1 Reagent to each cell. Swirl to mix.
5. Add 1.0 mL of Sulfide 2 Reagent to each cell. Swirl to mix. A pink color will develop, and then the solution will turn blue if sulfide is present.
6. Press: **TIMER** and **ENTER**. A **5-minute** reaction period will begin
7. When the timer expires, clean both cells and insert the blank into the cell holder. Tightly cover the sample cell with the instrument cap. Press **ZERO** and the display will show 0.00 mg/L S²⁻.
8. Place the prepared sample into the cell holder. Cover with instrument cap and press **READ** to get a result.

NOTE: It is advisable to carry out a dilution by a factor of 20 if **LIMIT** appears on screen.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Turbidity: This can be removed by simple filtration,

- Ba (> 20 mg/L),
- Reducing agents: the effect of these can be reduced by carrying out the test as quickly as possible after sampling.

9 DETERMINATION OF CYANIDE LEVELS (0.000 - 0.240 mg/L CN⁻)

Principle: Pyridine-pyrazolone reagent reacts with cyanide ions to give a blue complex, the intensity of which gets converted numerically by the colorimeter.

9.1 Required



Cyanide.pdf

- HACH DR/890 COLORIMETER
- CyaniVer 3 Cyanide Reagent Powder Pillows (Cat. 21068-69)
- CyaniVer 4 Cyanide Reagent Powder Pillows (Cat. 21069-69)
- CyaniVer 5 Cyanide Reagent Powder Pillows (Cat. 21070-69)
- 2 x 25 mL Sample Cells
- 5 N Sodium Hydroxide Solution and 2.5 N Hydrochloric acid for pH adjustment. *Note that concentrated hydrochloric acid has a normality of 12 N.*

9.2 Procedure

NOTE: *If the sample is to be preserved, the pH should be increased to above 12 by adding a few drops of 5N sodium hydroxide solution. Any volume changes need to be considered so that they are then taken into account when the final result is obtained. In addition, the sample needs to be then placed in the fridge and stored at 4 °C (or less) for up to 14 days.*

Before analysis the pH should be adjusted back to 7 with 2.5 N hydrochloric acid solution and sample temperature should increase to room temperature.

1. Switch on the colorimeter. Enter the stored program – **23**.
2. Fill a clean sample cell with 10 mL of sample. Add the contents of one CyaniVer 3 Cyanide Reagent Powder Pillow. Cap the sample cell.
3. Press **TIMER** and **ENTER** and a **30-second** reaction period will begin. Shake the sample cell for the entire time.
4. After the timer beeps, the display will show: **0:30 TIMER 2**. Press **ENTER** and let the sample cell sit undisturbed for this **30-second period**.
5. After the timer beeps, add the contents of one CyaniVer 4 Cyanide Reagent Powder Pillow, cap the sample cell and shake it for **10 seconds**.

NOTE: *Accuracy is not affected by undissolved CyaniVer 4 Cyanide Reagent Powder.*

6. Immediately add the contents of one CyaniVer 5 Cyanide Reagent Powder Pillow, cap the sample cell and shake to completely dissolve added reagent – the **Prepared Sample**.
7. Press **ENTER** for **TIMER 3** and a **30-minute** reaction period will begin.

NOTE: *If cyanide is present, a pink color will develop which then turns blue after a few minutes.*

8. Fill another sample cell with 10mL of sample – the **Blank**.
9. Place the blank into the cell holder. Cover with a cap and press **ZERO**.
10. Place the prepared sample into the cell holder. Cover the cap and press **READ** and get a value for the concentration of CN⁻ in mg/L.

NOTE: *It is advisable to carry out a dilution by a factor of 50 if LIMIT appears on screen.*

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Free chlorine: If large amounts of free chlorine. are present a milky white precipitate forms after the last step. In such case, dilute the sample.
- Sulfides and free fatty acids: It is ideal to test the sample within 24 hours of collection if sulfide levels and FFA content are quite high to prevent cyanide loss.
- Turbidity: This can be reduced by filtration before carrying out the analysis.

10 DETERMINATION OF SULFATE(VI) LEVELS (0 - 70 mg/L SO₄²⁻)

Principle: Sulfate ions in the sample react with barium ions in the SulfaVer 4 Sulfate Reagent to form insoluble barium sulfate. The amount of turbidity formed is proportional to the sulfate concentration. The SulfaVer 4 also contains a stabilizing agent to hold the precipitate in suspension.

10.1 Required

- HACH DR/890 COLORIMETER
- SulfaVer 4 Sulfate Reagent Powder Pillows (Cat. 21067-69)
- 2 x 25 mL Graduated Sample Cells



Sulfate (SulfVer 4 Method).pdf

10.2 Procedure

NOTE: *Samples may be stored for up to 28 days at 4 °C. Then, before analysis, they should be allowed to reach thermal equilibrium with room temperature.*

1. Switch on the colorimeter, press **PRGM** and enter the stored program – **91**.
2. If the sample is highly turbid or coloured it must be first filtered before proceeding.
3. Fill a clean sample cell with 10 mL of sample.
4. Add the contents of one SulfaVer 4 Sulfate Reagent Powder Pillow - the **Prepared Sample**. Cap the sample cell and invert several times to mix.

NOTE: Mixture will turn turbid if sulfate(VI) is present in the sample. Accuracy is not affected by any undissolved powder from the powder pillow.

5. Press **TIMER** and **ENTER** and a **5-minute reaction** period will begin. Allow the cell to stand undisturbed.
6. After the timer beeps, fill a second sample cell with 10 mL of sample – the **Blank**. Place the blank into the cell holder and tightly cover the sample cell with the instrument cap. Press **ZERO** and the display will show 0 mg/L SO_4^{2-} .
7. Place the prepared sample into the cell holder and cover with the instrument cap. Press **READ** and get the concentration of SO_4^{2-} in mg/L.

NOTE: It is advisable to carry out a dilution by a factor of 10 or 20 if **LIMIT** appears on screen.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

Mg (>10,000 mg/L), Ba (at all levels), Ca (> 20,000 mg/L), Cl^- (> 40,000 mg/L), SiO_2 (> 500 mg/L), turbidity.

Turbidity can be reduced by filtering the sample before the analysis.

11 DETERMINATION OF FREE CHLORINE LEVELS (0 - 2.50 mg/L Cl_2)

Principle: Chlorine-containing substances (ClO^- , HClO , Chloroamines) react with potassium iodide which then reacts with *N,N*-diethyl-*p*-phenylenediamine (DPD Free Chlorine Reagent) to produce a red coloured solution.

11.1 Required

- HANNA HI 83200 PHOTOMETER
- HANNA HI 93701-O DPD Free Chlorine Reagent
- Cuvette and Cap



HACH Free chlorine.pdf



HANNA Free Chlorine.pdf

11.2 Procedure

NOTE: *Samples should be collected in clean glass bottles because plastic containers have a large chlorine demand.*

Glass containers should be pre-treated with a weak bleach solution for 1 hour and then rinsed with deionized water to decrease their chlorine demand. If sample containers are rinsed fully with deionised water, pretreatment is required only occasionally.

1. Switch on the Photometer.
2. Select the Free Chlorine method by pressing **METHOD**, then scroll up/down the method list and finally press **SELECT** on method **Chlorine (Free)**.
3. Fill the cuvette with 10 ml of unreacted sample up to the mark and replace the cap.

NOTE: *Make sure that the cuvette is completely dry and clean before proceeding.*

4. Place the cuvette into the holder and close lid.
5. Press the **ZERO** key. The display will show “-0-“ which means that the meter is zeroed and ready for measurement.
6. Remove the cuvette and add the content of one packet of HI 93701-0 DPD Free Chlorine reagent. Replace the cap and shake gently for 20 seconds.

NOTE: *In case of water with alkalinity greater than 250 mg/L CaCO₃, the sample needs to be shaken for 2 minutes after adding the powder reagent.*

NOTE *In case of alkalinity greater than 250 mg/L CaCO₃ the colour of the sample may develop only partially or fade rapidly. In such case, neutralize sample with diluted HCl.*

NOTE: *Tap the cuvette several times to remove any air bubbles which would otherwise result in higher readings.*

7. Reinsert the cuvette into the instrument and close the lid.
8. Press **TIMER** and after 1 minute, the instrument displays the result in mg/L of Free Chlorine.

NOTE: *It is advisable to carry out a dilution by a factor of 10, 20, 30 or 40 if LIMIT appears on screen.*

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded. Possible solutions are listed next to some interferences.

- Acidity (>150 mg/L as CaCO₃): Adjust pH to 6-7 with the addition of 1N NaOH

- Alkalinity (>250 mg/L as CaCO₃): Adjust pH to 6-7 with the addition of 1N Sulfuric(VI) acid
- Bromine (all levels)
- Chlorine dioxide (all levels)
- Inorganic chloramines, chloramines (all levels)
- Hardness (>1000 mg/L)
- Manganese (no levels specified)
- Ozone (all levels)
- Peroxides (no levels specified)

12 DETERMINATION OF CHLORIDE (Cl⁻) LEVELS (0 – 100 or 0 – 1000 mg/L)

Principle: The chloride level in mg/L (ppm) is determined by a mercury(II) nitrate titration. The pH is lowered to approximately 3 by addition of nitric acid. Mercury(II) ions react with chloride ions to form mercury(II) chloride. When excess mercury(II) ions are present, they complex with diphenylcarbazone to form a purple solution. Hence, at the end point of the titration (when all chloride ions have reacted), a purple solution is formed because a slight excess of mercury(II) is present.

NOTE: Make sure that the sample is at room temperature before carrying out the titration.

12.1 Required

- HANNA Chloride Test Kit HI 3815
 - Diphenylcarbazone indicator, Nitric Acid Solution, HI 3815-0 Mercuric Nitrate Solution
 - 2 calibrated vessels (10 & 50 ml), 1 calibrated syringe with tip

12.2 Procedure

HIGH RANGE – 0 to 1000 mg/L Chloride



manual-hi3815-en.pdf

1. Remove the cap from the small plastic vessel and rinse it with water sample. Fill to the 5 ml mark and replace the cap.
2. Add 2 drops of Diphenylcarbazone indicator through the cap port and mix by carefully swirling the vessel in tight circles. The solution will become a reddish-violet color.
3. While swirling the vessel, add the Nitric Acid Solution dropwise until the solution turns yellow.

4. Take the titration syringe and push the plunger completely into the syringe. Insert tip into HI 383815-0 Mercuric Nitrate Solution and pull the plunger out until the lower edge of the plunger seal is on the 0 ml mark of the syringe.
5. Place the syringe tip into the cap part of the plastic vessel and slowly add the titration solution dropwise, swirling to mix after each drop. Continue adding titration solution until the solution in the vessel changes from yellow to violet.
6. Read off the volume of titrant (in mL) added from the syringe scale and multiply by 1000 to obtain mg/L (ppm) chloride.

LOW RANGE – 0 to 100 mg/L Chloride

If results are lower than 100mg/L, the test needs to be repeated by following the following procedure:

1. Remove the cap from the large plastic vessel. Rinse the vessel with the water sample, fill to the 50 mL mark and replace the cap.
2. Proceed with the test as described above for the high range measurement.
3. Read off the volume of titrant (in mL) added from the syringe scale and multiply the value by 100 (instead of by 1000) to obtain mg/L chloride in the sample.

13 DETERMINATION OF TOTAL FLUORIDE LEVELS (0 - 2.00 mg/L F⁻)

Principle: SPADNS2 reagent contains a non-toxic reducing agent to eliminate interferences from chlorine. Fluoride ions present in the sample combine with a red-zirconium dye to form a colourless complex. This means that the higher the concentration of fluoride ions the fainter the initial red colour of the dye becomes.



Fluoride (USEPA
SPADNS 2 Method).pr

13.1 Required

- HACH DR/890 COLORIMETER
- 2 x 25 mL Sample Cells
- Graduated Pipette (0.00 - 2.00 mL)
- SPADNS 2 (Arsenic-Free) Fluoride Reagent (Cat. 29475-49)
- Deionised water (DI water)

13.2 Procedure

NOTE: *Samples may be stored for up to 28 days at room temperature.*

NOTE: *Test is very sensitive to contamination. Glassware must be very clean (rinsed with acid followed by deionised water) before use.*

1. Switch on colorimeter and press **PRGM** before entering the stored program **27**.
2. Add 10.0 mL of sample to a dry 25 mL sample cell – the **Prepared Sample**.
3. Add 10.0 mL of deionized water into a second 25 mL sample cell – the **Blank**.
4. Pipette 2.00 mL of SPADNS 2 Reagent into each cell. Swirl to mix.
5. Press **TIMER** followed by **ENTER**. A **1-minute** reaction period will begin.
6. When the timer beeps, place the **Blank** in the cell holder. Tightly cover sample cell and press **ZERO**.
7. Then, insert the prepared sample into the cell holder, tightly cover sample cell and press **READ** to obtain reading in mg/L F.

NOTE: It is advisable to carry out a dilution by a factor of 5 if **LIMIT** appears on screen.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Cl^- (>7000 mg/L);
- Alkalinity (> 5000 mg/L);
- SO_4^{2-} (> 200 mg/L);
- PO_4^{3-} (> 16 mg/L);
- Fe(III) (>10 mg/L);
- Cl_2 (>5 mg/L);
- Al (>0.1 mg/L);
- Turbidity;

Possible solutions

- Take readings every 15 minutes to check whether aluminium interference is present. If values continue to change, leave the chemical reaction taking place for 2 hours before carrying the reading.
- Dilute sample to decrease the level of other interferences.

14 DETERMINATION OF TOTAL BORON LEVELS (0.05 - 2.50 mg/L B)

Principle: Borate ions (BO_3^{3-}), react with azomethine-H (in reagent) to form a yellow dye.

14.1 Required



LCK307-Boron.pdf

- HACH DR 1900 SPECTROPHOTOMETER
- Graduated Pipette (1.0 – 5.0 mL) or Automatic Pipette with the appropriate Tip
- Graduated Pipette (0.00 – 1.00 mL) or Automatic Pipette with the appropriate Tip

- HACH LCK 307 Test Kit (stored at 2 – 8 °C)
 - Solution A
 - Test Cuvette
- 5 N Sodium Hydroxide and concentrated Nitric(V) acid (for pH adjustment)

14.2 Procedure

1. Switch on spectrophotometer. Press the **TOOL KEY** and go to **ALL PROGRAMS/METHODS**. Select **LCK or TNT plus Methods**, scroll up/down and select the stored program number **307**.

NOTE: *The sample pH should be adjusted to 4 - 9. The sample temperature must be approximately 20 °C because the reaction is very temperature dependent.*

Sample should be free of any turbidity. Turbidities need to be eliminated by filtration through a membrane filter.

2. Use a pipette to add 1.00 mL of Solution A to the test cuvette.
3. Use a pipette to add 2.50 mL of sample to the test cuvette.
4. Fit the rubber cap on the test cuvette and invert until completely mixed.
5. Allow **40 minutes** for the reaction to take place.
6. Clean the vial with a wet cloth followed by a dry one.
7. Insert the vial into the cell holder, press **READ** and the result in mg/L B is shown.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Mn(II), Zn(II), Ca(II), Mg(II), Na(I), K(I), PO_4^{3-} , SO_4^{2-} , NO_3^- (>1000 mg/L);
- Cl^- , NH_4^+ (>500 mg/L);
- Fe(II), Fe(III) (>25 mg/L)
- Turbidity: This is removed or reduced sufficiently by filtration

15 TOTAL VS DISSOLVED METAL DETERMINATION



WATER ANALYSIS
GUIDE.pdf

In order to calculate the TOTAL CONCENTRATION of each metal analyte, digestion is required because organic material may inhibit or interfere with certain reactions. In addition, most metals form insoluble precipitates at high pH and hence these must be brought back in solution.

1. Add concentrated nitric acid to the sample with a glass pipette and pipette filler:

- a. If the sample was acidified for preservation, add 3 mL of concentrated nitric(V) acid to 1 liter of the preserved sample.
- b. If the sample was not acidified for preservation, add 5 mL of concentrated nitric(V) acid to 1 liter of the sample.
2. Transfer 100 mL of acidified sample to a 250-mL conical flask.
3. Add 5 mL of 6 N hydrochloric acid.
4. Put the sample on a hot plate at 95 °C (203 °F) until 15 – 20 mL of the sample remains. Make sure that the sample does not boil.
5. Filter the cooled sample through a 0.45-µm filter to remove any insoluble material.
6. Adjust the pH of the digested sample to pH 4–5 with 5.0 N sodium hydroxide.
7. Quantitatively transfer the sample to a 100-mL volumetric flask and dilute to the mark with DI water.

In order to calculate the DISSOLVED CONCENTRATION of each and every metal, the sample should be first filtered through a 0.45 µm filter and then the pH is adjusted to the specific value required for the test. Any volume changes are noted and taken into consideration in the final result.

16 DETERMINATION OF CHROMIUM LEVELS (0 - 0.60 mg/L Cr)

Principle: Any chromium(III) gets oxidized to chromium(VI) by hydrobromite under alkaline conditions. Then, the sample is acidified before 1,5-diphenylcarbazone is added which complexes with chromium(VI) to give a purple solution.

16.1 Required

- HACH DR/890 COLORIMETER
- HACH Chromium 1 Reagent Powder Pillows (Cat. 2043-99)
- HACH Chromium 2 Reagent Powder Pillows (Cat. 2044-99)
- HACH Acid Reagent Powder Pillows (Cat. 2126-99)
- HACH ChromaVer 3 Chromium Reagent Powder Pillows (Cat. 12066-99)
- Hot plate and 100 mL beaker for water bath
- 2 x 25 mL Sample Cells
- Water, Deionized
- 5.0 N Sodium Hydroxide and concentrated Nitric(V) acid for pH adjustment



Chromium, Total.pdf

16.2 Procedure

NOTE: Collecte samples in clean glass or plastic bottles that have been previously rinsed with 6N hydrochloric acid followed by deionised water

NOTE: *In order to store samples, the pH needs to be lowered to <2 by the addition of Concentrated Nitric(V) acid. Subsequently, they can be retained at room temperature for up to six months. Before analysis, the pH should be adjusted to about 4 with the addition of 5.0 N Sodium Hydroxide.*

1. Switch on colorimeter. Press **PRGM** and enter the stored program for total chromium – **15**.
2. Fill a clean sample cell with 25 mL of wastewater.
3. Add the contents of one Chromium 1 Reagent Powder Pillow (the **Prepared Sample**). Cap the cell, invert to mix. Remove the cap.
4. Place the prepared sample into a boiling water bath.
5. Press **TIMER** and then **ENTER**. A **5-minute** reaction period (labelled as **TIMER 1**) will begin.
6. After the beeper beeps, remove the prepared sample. Cap the cell and use running tap water to cool the cell to room temperature.
7. Add the contents of one Chromium 2 Reagent Powder Pillow. Cap the cell and invert repeatedly to mix. Remove the cap.
8. Add the contents of one Acid Reagent Powder Pillow. Cap the cell and invert repeatedly to mix. Remove the cap.
9. Add the contents of one ChromaVer 3 Chromium Reagent Powder Pillow. Cap the cell and invert repeatedly to mix.

NOTE: *A purple color will form if chromium is present.*

NOTE: *ChromaVer 3 is white to tan in color. Replace brown or green powder. Undissolved powder does not affect accuracy.*

10. Start the 5-minute reaction period by pressing **ENTER** when display shows **05:00** **TIMER 2**.
11. After the timer beeps, fill another sample cell with 25 mL of sample (the blank). Place it into the cell holder, tightly cover the sample cell with instrument cap and press **ZERO**.
12. Place the prepared sample into the cell holder, tightly cover the sample cell with instrument cap and press **READ**. The result in mg/L total chromium (Cr) will be displayed.

NOTE: *For turbid samples, in order to prepare the blank, repeat the procedure on a sample of wastewater but up to step 8. Do not add ChromaVer 3 Chromium Reagent Powder Pillow.*

NOTE: *It is advisable to carry out a dilution by a factor of 10 if **LIMIT** appears on screen.*

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Organic matter: This can be removed by digestion
- Turbidity: This can be reduced by filtration

17 DETERMINATION OF SILVER LEVELS (0.02 – 0.70 mg/L Ag)

Principle: Silver ions react with cadion 2B (a type of azo dye with two azo (N=N) bonds) in basic conditions to form a green to brown to red-purple complex. Sodium thiosulfate decolourizes this colour in the blank.

17.1 Required



Silver (Colorimetric Method).pdf

- HACH DR 1900 SPECTROPHOTOMETER
- HACH Silver 1 Reagent Powder Pillow (Cat. 2293566)
- HACH Silver 2 Reagent Solution Pillow (Cat. 2293666)
- HACH Sodium Thiosulfate Reagent Powder Pillow (Cat. 2293766)
- 50 mL Graduated Measuring Cylinder
- Deionised Water (DI)
- 6 N Hydrochloric Acid Solution (Prepared by diluting (12 N) concentrated hydrochloric acid with an equivolume of deionised water).
- 5 N Sodium Hydroxide Solution and Concentrated Nitric(V) acid for pH adjustment
- 2 x 10 mL Sample Cells

17.2 Procedure

NOTE: Collect samples in clean glass or plastic bottles that have been previously cleaned with 6 N hydrochloric acid and rinsed with deionised water.

NOTE: Analyze the sample as soon as possible for best results. To preserve samples adjust the pH to lower than 2 by the addition of concentrated nitric(V) acid. If sample contains suspended particles, filter through a 0.45 µm filter before adding the acid. Preserved sample can be kept at room temperature for up to 6 months.

1. Just before the analysis, increase the pH to **9 – 10** by adding drops of 5 N sodium hydroxide solution.
2. Switch on the spectrophotometer, press the **TOOL** button, choose **ALL PROGRAMS/ METHODS**, then choose **STORED PROGRAMS/METHODS**, scroll up and down and select the program **660 Silver** by pressing **START on the mentioned program**.
3. Add the contents of one Silver 1 Powder Pillow to a **dry** 50 mL mixing cylinder. If the powder becomes wet due to presence of moisture in the cylinder, it will not fully dissolve and the color will not fully develop.
4. Add the contents of one Silver 2 Reagent Solution Pillow to the mixing cylinder.

5. Swirl to mix. If there are clumps of dry powder when the sample is poured in, the powder will not fully dissolve, and the colour will not develop completely.
6. Using a graduated cylinder, add sample water to the mixing cylinder up to the 50-mL mark. Put the stopper on the mixing cylinder and invert continuously to mix for 1 minute.
7. Prepare the **Sample**: Pour 10 mL of the sample from the mixing cylinder into a sample cell.
8. Prepare the **Blank**: Discard all but 25 mL of the mixture from the mixing cylinder.
9. Add the contents of one Sodium Thiosulfate Reagent Powder Pillow to the remaining solution. (Make sure to prepare a blank for each sample).
10. Put the stopper on the mixing cylinder. Invert the mixing cylinder several times to mix.
11. Start the instrument timer for a **2-minute reaction period**.
12. Subsequently, pour 10 mL of the solution from the mixing cylinder into a second sample cell. This is the **blank**.
13. When the timer expires, clean the Blank sample cell, insert into the cell holder. Push **ZERO**. Display will show 0.00 mg/L Ag.
14. Clean the outside of the Prepared Sample cell. Then, insert it into the cell holder. Push **READ**. Results show in mg/L Ag.
15. Immediately rinse the sample cells.

NOTE: It is advisable to carry out a dilution by a factor of 10 if *LIMIT* appears on screen.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

Al(>30 mg/L), NH₃ (>750 mg/L), Cd (> 15 mg/L), Ca (>600 mg/L), Cl⁻ (>19 mg/L), Cu (>7 mg/L), Cr(VI) (>90 mg/L), Fe (>30mg/L), Pb (>13 mg/L), Mn (>19 mg/L), Mg (>2000 mg/L), Hg (>2 mg/L), Ni (>19 mg/L), Zn (70 mg/L).

18 DETERMINATION OF NICKEL LEVELS (0.006 – 1.000 mg/L Ni)

18.1 Required

- HACH DR1900 SPECTROPHOTOMETER
- PAN Indicator Solution 0.3% (Cat. 2150232)
- 2 x EDTA Reagent Powder Pillows (Cat. 700599)
- 2 x Phthalate – Phosphate Reagent Powder Pillows (Cat. 700599)
- 2 x 25 mL Sample Cells
- Deionised water



Nickel (PAN
Method).pdf

18.2 Procedure

NOTE: Collect samples in clean glass or plastic bottles that have been previously cleaned with 6 N hydrochloric acid and rinsed with deionised water.

NOTE: To preserve samples for later analysis adjust the pH to less than 2 by the addition of concentrated nitric(V) acid. Preserved samples can be kept at room temperature for up to 6 months.

NOTE: The pH of the sample should be between 3 and 8. pH can be adjusted by the addition of 5.0 N Sodium hydroxide. Always correct test result for dilution caused by volume additions.

1. Switch on spectrophotometer. Press the **TOOL KEY** and go to **ALL PROGRAMS/METHODS**. Select **LCK or TNT plus Methods**, scroll up/down and select the stored program number **340 Nickel PAN**.
2. Fill a sample cell with 10 mL of deionised water (**Blank**) and another separate one with 10 mL of sample (**Sample**).
3. Add the contents of one Phthalate-Phosphate Reagent Powder Pillow to each cell. Close the cells with the caps and shake to dissolve reagent.
4. Add 0.5 mL of 0.3% PAN Indicator Solution to each cell. Close the cells with the caps and invert several times to mix well.
5. Start the instrument timer so that a 15-minute reaction time starts. At the end of this period the blank solution should be yellow whilst the sample solution should be from yellow to dark red.
6. After the timer expires, add the contents of one EDTA Reagent Powder Pillow to each cell. Close and shake well to dissolve all powder.
7. Clean each sample cell with a damp tissue followed by a dry one.
8. Insert the **Blank** into the cell holder in the spectrophotometer. Press **ZERO** and display should show 0.000 mg/L Ni.
9. Remove **Blank** and insert **Sample** into the cell holder. Push **READ** and the Ni concentration should be shown in mg/L.

NOTE: It is advisable to carry out a dilution by a factor of 5 if **LIMIT** appears on screen.

NOTE: The above procedure can be repeated for the analysis of cobalt. In case both nickel and cobalt need to be analysed the test procedure is followed once and the sample and blank containers are used for both analytes. The program number for Cobalt is **110 Cobalt**.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

Al³⁺ (>32 mg/L), Ca²⁺ (>1000 mg/L), Cd(II) (>20 mg/L), Cl⁻ (>8000 mg/L), EDTA (all levels), Cr(III) (>20 mg/L), Cr(VI) (>40 mg/L), Cu(II) (>15 mg/L), F⁻ (>20 mg/L), Fe(III) (>10 mg/L), Fe(II), K⁺ (>500 mg/L), Mg²⁺ (>25 mg/L), Mn(II) (>25 mg/L), Mo(VI) (>60 mg/L), Na⁺ (>5000 mg/L), Pb(II) (>20 mg/L), Zn(II) (>30 mg/L).

19 DETERMINATION OF COPPER LEVELS (0.00 - 5.00 mg/L Cu)

Principle: Copper reacts with bicinchoninate to form a purple coloured complex.



Copper (USEPA
Bicinchoninate Method)

NOTE: Collect samples in clean glass or plastic bottles that have been previously cleaned with 6 N hydrochloric acid and rinsed with deionised water.

NOTE: To preserve samples for later analysis adjust the pH to less than 2 by the addition of concentrated nitric(V) acid. Preserved samples can be kept at room temperature for up to 6 months.

NOTE: The pH of the sample should be between 6 and 8. pH can be adjusted by the addition of 5.0 N Sodium hydroxide. Always correct test result for dilution caused by volume additions.

19.1 Required

- HANNA HI 83200 PHOTOMETER
- HANNA HI 93702 Bicinchoninate Copper HR Reagent
- Cuvette and Cap
- 5 N Sodium Hydroxide and Concentrated Nitric(V) acid (for pH adjustment)

19.2 Procedure

1. Select the Copper HR method from the list of photometer methods.
2. Check the pH of the sample and if necessary adjust it to lie between 6 and 8.
3. Fill the cuvette with 10 mL of unreacted sample up to the mark and replace the cap.
4. Place the cuvette into the holder and close lid.
5. Press the **ZERO** key. The display will show “-0-“ which means that the meter is zeroed and ready for measurement.
6. Remove the cuvette.
7. Add the contents of one packet of HI 93702 Bicinchoninate Copper HR Reagent. Replace the cap and shake gently for about 15 - 20 seconds until all of the powder dissolves.
8. Tap the cuvette on a flat surface and leave it to rest for a few seconds so that all air bubbles rise upwards burst.
9. Reinsert the cuvette into the instrument.

10. Press **TIMER** and the display will show the countdown prior to the measurement. When the timer ends the instrument displays concentration in mg/L of Copper.

NOTE: *It is advisable to carry out a dilution by a factor of 4 if LIMIT appears on screen.*

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- Al(III), CN⁻, Hardness, Fe(III), Ag(I)

20 DETERMINATION OF ZINC LEVELS (0 - 3.00 mg/L Zn)

Principle: Zinc and other metals in the sample complex with cyanide ions in the reagent powder pillow to form an orange solution. Adding cyclohexanone selectively releases zinc. The zinc then reacts with the 2-carboxy-2'-hydroxy-5'-sulfoforamazybenzene (in powder pillow) and forms a blue color whose intensity is proportional to the zinc concentration.

20.1 Required

- HACH DR/890 COLORIMETER
- 2 x 25 mL Sample Cells
- HACH ZincoVer 5 Zinc Reagent Powder Pillow (Cat. 21066-69)
- HACH Cyclohexanone (Cat. 1403332)
- Graduated Pipette (0.0 - 5.0 mL)
- Graduated Pipette (0.00 - 1.00 mL)
- Hydrochloric Acid Solution, 6 N (prepared by diluting concentrated (12 N) hydrochloric acid with an equivolume of deionised water)
- Concentrated Nitric(V) acid and 5.0 N Sodium Hydroxide for pH adjustment
- Deionised water (DI water)



Zinc (USEPA Zincon Method).pdf

20.2 Procedure

NOTE: *In order to store the samples, the pH needs to be adjusted to <2 by the addition of concentrated nitric(V) acid. The preserved samples can be then stored for up to 6 months at room temperature. Before analysis, adjust the pH to 4 – 5 with 5.0 N Sodium Hydroxide. Do not exceed this pH as zinc (in the form of the hydroxide) may precipitate.*

1. Switch on colorimeter and press **PRGM** before entering the stored program number **97**.
2. Rinse glassware with 6 N hydrochloric acid and deionized water before use.
3. Fill a 25-mL sample cell with 20 mL of sample.

4. Add the contents of one packet of ZincoVer 5 Zinc Reagent Powder Pillow. Cap and invert several times to completely dissolve the powder. If the sample does not turn orange but brown or blue, repeat the test on a diluted version of the sample (use DI water as the diluent).
5. Measure 10 mL of the orange solution into another sample cell – the **Blank**.
6. Add 0.5 mL of Cyclohexanone to the remaining orange solution in the first sample cell (the **Prepared Sample**).
7. Tightly cap the cell (the **Prepared Sample**). Shake vigorously for 30 seconds. The sample will be red-orange, brown or blue, depending on the zinc concentration.
8. Press **TIMER** and then **ENTER**. A **3-minute** reaction period will begin.
9. When the timer beeps, immediately place the blank in the adapter, tightly cover the sample cell and press **ZERO**.
10. Immediately after, insert the prepared sample into the cell holder, tightly cover the sample cell and press **READ** to obtain reading in mg/L Zn.

NOTE: *It is advisable to carry out a dilution by a factor of 5 if **LIMIT** appears on screen.*

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

Al (>6 mg/L); Cd (>0.5 mg/L); Cu (>5 mg/L); Fe(III) (>7 mg/L); Mn (>5 mg/L); Ni (>5 mg/L); Organic material (this can be removed by digestion).

21 DETERMINATION OF LEAD LEVELS (0.1 - 2.0 mg/L Pb)

Principle: Lead(II) ions at pH 9 react with 4-(2-pyridylazo)-resorcinol (A phenolic azo dye) to form a red complex, the colour-intensity of which gets converted to a numerical concentration value by the spectrophotometer.

21.1 Required

- HACH DR 1900 SPECTROPHOTOMETER
- 6 N Hydrochloric Acid
- Concentrated Nitric(V) Acid
- Deionized Water
- 5N Sodium Hydroxide Solution
- HACH LCK 306 Lead Test kit:
 - Reagent A
 - Solution B
 - Solution C
 - Test cuvette
- Graduated Pipette (1.0 – 5.0 mL)



LCK306.pdf

- Graduated Pipette (0.00 – 2.00 mL)
- Graduated Pipette (0.00 – 1.00 mL)
- Graduated 25 mL Reaction Tube

21.2 Procedure

NOTE: *In order for reaction to take place the pH should be between 3 and 9.*

NOTE: *Samples which are free from complexing agents and have a pH between 3 and 6 can be analysed directly. Samples with a pH between 6 and 9 must be additionally digested in order to bring undissolved lead compounds into solution.*

NOTE: *The sample temperature and reagent temperature needs to be between 15 and 25°C for an accurate result.*

1. Switch on spectrophotometer. Press the **TOOL KEY** and go to **ALL PROGRAMS/METHODS**. Select **LCK or TNT plus Methods**, scroll up/down and select the stored program number **306**.
2. Add 10 mL of sample to a 25 mL graduated reaction tube.
3. Add one level spoonful of Reagent A to the reaction tube.
4. Tighten the cap on the reaction tube and invert the repeatedly.
5. Wait for **2 minutes**.
6. Then, use a graduated pipette to add 1.50 mL of Solution B to the test cuvette.
7. Use a graduated pipette to add 4 mL of the pretreated sample from the reaction tube to the cuvette.
8. Tighten the cap on the reaction tube and invert the cuvette 2 – 3 times.
9. Wait for **2 further minutes**
10. Insert the vial into the cell holder. Push **Read 1** to set the instrument to zero.
11. Use a graduated pipette to add 0.3 mL of Solution C to the same test cuvette.
12. Tighten the cap on the reaction tube and invert the cuvette 2 – 3 times – thoroughly clean the outside of cuvette.
13. Wait for **1 minute**.
14. Insert the vial with the prepared sample into the cell holder, press **READ** and the result in mg/L Pb is shown.

Interferences

The following parameters may cause interference if certain levels (in brackets) are exceeded:

- K, Na, Ca, Mg, NO_3^- , Cl^- , PO_4^{3-} , CO_3^{2-} , SO_4^{2-} (> 500 mg/L);
- F, NH_4^+ , Sr(II) (> 50 mg/L);
- Ag(I), Cd(II), Cr(VI), Zn(II), Cu(II), Co(II), Ni(II) (>25 mg/L);
- Cr(III), Al, Fe(II, III) (>10 mg/L);

- Mn(II), Hg(II) (>5 mg/L);
- Sn(II) (0.5 mg/L)

22 DETERMINATION OF TOTAL ARSENIC LEVELS (0 - 500, 0 - 4000 ppb As)

Principle: The Marsh test treats the sample with sulfuric acid and arsenic-free zinc. Even if there are very small concentrations of arsenic, the zinc reduces the trivalent arsenic (As^{3+}) to arsane:



Arsane reacts with mercury bromide strips to form a yellow/brown spot; whose intensity depends on the concentration of arsenic in the sample.

Using the Qunatofix Arsen 10 kit



91334en.pdf

22.1 Required

- Test strip
- 1 bottle of As-1
- 1 bottle of As-2
- 1 bottle of As-3
- 1 reaction vessel
- 1 syringe 10 mL
- 1 needle

22.2 Procedure

1. Using the 10-mL syringe, transfer (10 x 3) 30 mL of the sample into the reaction vessel. Then add:
 - a. 1 drop of As-1
 - b. 1 measuring spoon of As-2
 - c. 1 measuring spoon of As-3
2. Shake for about 2 seconds and immediately after dip a test strip about 2 cm deep in the reaction vessel.
3. Fit the lid and pierce it with a needle. Leave the needle in the lid.
4. Wait for 10 minutes and then dip the test strip into a container of distilled water for 2 seconds.
5. Shake off the excess distilled water and compare the test strip with the colour scale on the container containing the test strips.

23 DETERMINATION OF TOTAL PHOSPHORUS LEVELS (0.00 - 15.00 mg/L P)

Principle: Phosphorous in organic (in proteins and amino acids) and inorganic forms gets converted to phosphate(V) ions before they react with ammonium molybdate (Reagent A) to form molybdophosphoric acid. In the presence of the amino acid reagent (Reagent B), the acid is reduced to form a blue molybdenum compound.

23.1 Required

- HANNA HI 83200 PHOTOMETER
- HANNA HI 93706A-0 Phosphorus Reagent A
- HANNA HI 93706B-0 Phosphorus Reagent B
- Cuvette and Cap

23.2 Procedure

1. Select the **Phosphorus** method from the list of photometer methods.
2. Fill the cuvette up to the mark with 10mL of unreacted sample and replace the cap.
3. Place the cuvette into the holder and close lid.
4. Press the **ZERO** key. The display will show “-0-“ which means that the meter is zeroed and ready for measurement.
5. Remove the cuvette and add 10 drops of HI 93706A-0 Phosphorus Reagent A.
6. Add the contents of one packet of HI 93706B-0 Phosphorus Reagent B. Shake.
7. Reinsert the cuvette into the instrument.
8. Press **TIMER**. A **5-minute** reaction period will begin.
9. When the timer ends the meter will perform the reading of Phosphorus in mg/L.

NOTE: *It is advisable to carry out a dilution by a factor of 2 if LIMIT appears on screen.*

24 BIOLOGICAL OXYGEN DEMAND (B.O.D.) LEVELS (0 – 1000 mg/L O₂)

24.1 Required

- VELP BOD Sensor
- Potassium Hydroxide pellets
- Rubber Alkali Holder
- 250 mL Graduated Measuring Cylinder
- Dark Glass Bottle (500ml)
- VELP Stirring Station
- VELP Refrigerated Thermostat (20.0 ± 0.5 °C)

- Stirring bar
- PC with BODSoft™ software and BOD EVO Wireless DataBOX™

24.2 Procedure


- 1) Fill a dark glass bottle with of the volume of sample according to adopted scale(measured using a 250 mL graduated measuring cylinder).The following table assigns the volumes needed for each scale (related to expected BOD value) which is used:

Scale (mg of O ₂ /L)	Volume of sample (mL)
0 – 999	100
0 – 600	150
0 – 250	250
0 – 90	400

NOTE: Ranges can be extended by using diluted samples. Always use distilled water as the diluent because deionised water may contain covalent compounds that do not get removed in the process of its production.

- 2) Add a stirring bar into each bottle.
- 3) Fix the Alkali Holder to the bottle neck and fill carefully with potassium hydroxide pellets (carbon dioxide absorber) making sure that the pellets do not cover the holder holes. If some alkali falls into bottle, wash thoroughly before re-pouring volume of sample under examination.
- 4) Before starting a new measuring cycle, it is requested to reset the stored values. To reset: press the keys **SET** and **START** simultaneously for about 5 seconds until **DEL** appears on screen. In this way previous data points are deleted.
- 5) Go to the VELP software BODSoft™ on the PC and enter the required information in the sheet
 - a. Sample Name
 - b. Sample Volume (mL)
- 6) Press the button **SET** on the BOD Sensor for **5 – 10** seconds until a dialogue box appears on PC screen on the VELP software BODSoft™ in which the Sensor number (as indicated on the VELP BOD Sensor) is inputted. Press **OK**.
- 7) Continue inputting the following information in the software BODSoft™:
 - a. Scale (mg/L) - This is taken as 250 mg/L O₂ [depends on volume – take note of below table].
 - b. Duration Analysis (d) – For our reporting purposes, this value should be set to 5 days.

- c. Sampling time (h) – This is typically set to 1 hour.
 - d. Sensor Number – This is the number on the BOD Sensor which is fixed to the bottle.
-
- 8) Place the bottle with the stirring bar on Stirring Station (connected stirring station is found in the refrigerated thermostat, which should be set at 20.0 ± 0.5 °C)
 - 9) After thermal equilibrium is reached (30-40 minutes), screw the BOD Sensor tightly onto the bottle.
 - 10) On the BOD Sensor, press **SET** and then **START** to start the measurement cycle.
 - 11) The “Opened Lock” symbol at the left-hand side of the row in which the data was inputted in the VELP software™ BODSoft changes to a “Closed Lock” and then to a “Green Triangle” which means that measuring cycle has started.
 - 12) BOD results can be obtained after 5 days, by selecting the correct entry in the VELP software BODSoft™, go to the toolbar and press **REPORT** and then **CREATE**.
 - 13) Give a name to the Excel file and select the Storage Location. An excel file with an information sheet is created containing a table with the inputted information and a graph of B.O.D. (mg/L) against time (days).
 - 14) Take note of the Final BOD value and Print the Excel Sheet.

		ANALYSIS OF WASTEWATER	
Prepared by:	Roderick Abdilla	Approved by:	
Issue Date:		Updated on:	26/03/2020

25 Summary of conditions for each test

Test Parameter	pH required	Temperature (°C)	Any other requirements	Interferences (highlighted in yellow are the most likely to interfere in our samples)
Chromium	4	N/A	Digestion is needed to remove organic matter; filtration removes turbidity	Organic matter, turbidity
Nickel/Cobalt	3 – 8	RT	Digestion is needed to remove organic matter and turbidity	Al ³⁺ (>32 mg/L), Ca ²⁺ (>1000 mg/L), Cd(II) (>20 mg/L), Cl ⁻ (>8000 mg/L), EDTA (all levels), Cr(III) (>20 mg/L), Cr(VI) (>40 mg/L), Cu(II) (>15 mg/L), F ⁻ (>20 mg/L), Fe(III) (>10 mg/L), Fe(II), K ⁺ (>500 mg/L), Mg ²⁺ (>25 mg/L), Mn(II) (>25 mg/L), Mo(VI) (>60 mg/L), Na ⁺ (>5000 mg/L), Pb(II) (>20 mg/L), Zn(II) (>30 mg/L), organic matter
Lead	3 – 9	15 – 25	Digestion is needed to remove organic material	K, Na, Ca, Mg, NO ₃ ⁻ , Cl ⁻ , PO ₄ ³⁻ , CO ₃ ²⁻ , SO ₄ ²⁻ (> 500 mg/L); F ⁻ , NH ₄ ⁺ , Sr(II) (> 50 mg/L); Ag(I), Cd(II),

				Cr(VI), Zn(II), Cu(II), Co(II), Ni(II) (>25 mg/L); Cr(III), Al, Fe(II, III) (>10 mg/L); Mn(II), Hg(II) (>5 mg/L); Sn(II) (0.5 mg/L)
Zinc	4 – 5	RT	Digestion is needed to remove organic matter	Al (>6 mg/L), Cd (>0.5 mg/L), Cu (>5 mg/L), Fe(III) (>7 mg/L), Mn (>5 mg/L), Ni (>5 mg/L), organic material
Boron	4 – 9	20 °C	Filtration is needed to remove turbidity	Mn(II), Zn(II), Ca(II), Mg(II), Na(I), K(I), PO ₄ ³⁻ , SO ₄ ²⁻ , NO ₃ ⁻ (>1000 mg/L); Cl ⁻ , NH ₄ ⁺ (>500 mg/L); Fe(II), Fe(III) (>25 mg/L), turbidity
Copper	4 – 6	RT	Digestion is needed to remove organic matter	Aluminium, cyanide, hardness, iron(III), silver(I)
Silver	9 – 10	RT	Digestion is needed to remove organic matter and turbidity	Al(>30 mg/L), NH ₃ (>750 mg/L), Cd (> 15 mg/L), Ca (>600 mg/L), Cl ⁻ (>19 mg/L), Cu (>7 mg/L), Cr(VI) (>90 mg/L), Fe (>30mg/L), Pb (>13 mg/L), Mn (>19 mg/L), Mg (>2000 mg/L), Hg (>2 mg/L), Ni (>19 mg/L); Zn (70 mg/L), organic matter
Arsenic		RT		S ²⁻ (>5 mg/L), Se (>1 mg/L), Sb (> 0.25 mg/L),
Total Nitrogen	3 – 12	15 – 25		Cl ⁻ (>5000 mg/L); COD (>2500 mg/L)
Nitrate(III)	3 – 10	15 – 25	Not more than 3 hours should elapse between sampling and	Cl ⁻ , SO ₄ ²⁻ (>2000 mg/L); K ⁺ , NO ₃ ⁻ (>1000 mg/L);

			analysis of sample	NH ₄ ⁺ , PO ₄ ³⁻ , Ca ²⁺ (500 mg/L); Mg ²⁺ (>100 mg/L), Cr(III) (>50 mg/L); Co(II), Zn (II), Cd(II), Mn(II), Hg(II) (>25 mg/L); Ni(II) (>12 mg/L), Ag(I), Fe(II) (>10 mg/L), Sn(IV), Fe(III) (> 5 mg/L)
Nitrate(V)	3 – 10	20 – 24	Not more than 3 hours should elapse between sampling and analysis of sample NO ₂ ⁻ should be removed by the addition of amidosulfonic acid Cl ⁻ should be removed by addition of silver sulfate(VI)	K ⁺ , Na ⁺ , Cl ⁻ (> 500 mg/L); Ag ⁺ (> 100 mg/L); Pb(II), Zn(II), Ni(II), Fe(III), Cd(II), Sn(II), Ca(II), Cu(II) (> 50 mg/L); Co(II), Fe(II) (>10 mg/L); Cr(VI) (> 5 mg/L); NO ₂ ⁻ (>2 mg/L)
Cyanide	7	25	Filtration is needed to remove turbidity Test should be performed as quickly as possible after sampling to prevent cyanide loss by the reaction with oxidizing agents	Oxidizing agents (free chlorine, if large amounts are present a milky white precipitate forms after the last step), Sulfides, fatty acids, turbidity
Sulfide	Sample pH	RT	Samples should be analysed immediately; agitation and sample exposure to air should be limited as much as possible samples immediately	Turbidity, Ba (> 20 mg/L), reducing agents
Fluoride	Sample pH	RT	Glassware should be extremely clean (by acid followed by deionised water) before analysis Sample should be filtered to remove turbidity Readings should be taken every	Cl ⁻ (>7000 mg/L); Alkalinity (> 5000 mg/L); SO ₄ ²⁻ (> 200 mg/L); PO ₄ ³⁻ (> 16 mg/L); Fe(III) (>10 mg/L); Cl ₂ (>5 mg/L); Al

			15 minutes to check whether aluminium interference is present Sample should be diluted to remove free chlorine interference	(>0.1 mg/L); Turbidity
Free chlorine	6 - 7	RT	Samples should be analysed immediately. Samples should be collected in clean glass bottles because plastic containers have a large chlorine demand. Glass containers should be pre-treated with a weak bleach solution for 1 hour and then rinsed with deionized water. If sample containers are rinsed fully with deionised water, pretreatment is required only occasionally.	Acidity (>150 mg/L as CaCO ₃); Alkalinity (>250 mg/L as CaCO ₃); Bromine (all levels); Chlorine dioxide: (all levels); Inorganic chloramines, chloramines (all levels); Hardness (>1000 mg/L); Manganese; Ozone (all levels); Peroxides
Sulfate(VI)	Sample pH	RT	Sample should be filtered to remove turbidity	Mg (>10,000 mg/L), Ba (at all levels), Ca (> 20,000 mg/L), Cl ⁻ (> 40,000 mg/L), SiO ₂ (> 500 mg/L), turbidity
COD	Sample pH	RT	Test biologically active samples as soon as possible	Cl ⁻ (>20,000 mg/L)

26 Bibliography

- Instruction Manual HI 4521 & HI 4522 pH/mV/Temperature/Conductivity/Resistivity/TDS/Salinity Bench Meters.
- DR/890 Colorimeter Procedures Manual
- DR/1900 Spectrophotometer Procedures Manual
- Instruction Manual HI83200 Multiparameter Bench Photometer for Laboratories.
- VELP SCIENTIFICA Instruction Manual

CONTROLLING CO and TOC IN FLUE GAS

HOW TO CONTROL CO AND TOC GENERATION IN FLUE GAS

Two main flue gas components generated from the Incineration process are CO and TOC. CO (or Carbon Monoxide) also called **carbonous oxide**, is a colorless, odorless, and tasteless gas that is slightly lighter than air. It can be toxic to humans and animals when encountered in high concentrations. In the atmosphere however, it is short lived and spatially variable, since it combines with oxygen to form carbon dioxide and ozone.

TOC or Total Organic Compounds include all the organic compounds in the effluent stream which are not burnt in the SCC.

Very often high CO will lead to high TOC.

In order to maintain low CO and TOC, it is important to

1. Maintain high temperatures in the PCC and SCC.
2. Ensure that the Oxygen Content in the SCC is more than 6%.
3. Loading of large quantity of waste in PCC that produce a lot of VOCs when incinerated such as paints.

In case that the CO and TOC goes up it is important to:

1. Stop waste loading until emissions go down.
2. If the temperature in SCC is low, increase temperature either by loading dry waste or by increasing the power of the burner.
3. If the oxygen is low, increase the velocity of the blower of the PCC from the inverter.

CONTROLLING CO and TOC IN FLUE GAS

4. If the velocity is set at maximum and the Oxygen level is still low, switch on the vertical column blower as well, taking into consideration the velocity of the ID Fan.
5. If the ID Fan velocity has reached 50Hz, don't try to increase more oxygen because hazardous smoke will come of the PCC. In such case reduce the rotation of the PCC Drum and wait for the waste to combust.
6. If the problem persists, then it is evident that the boiler is blocked and may need to be switched off for cleaning. In such case inform the Plant Engineer.
7. If CO is low but TOC is high, then there must be something wrong with the emissions instrument. In such case report to the Scientist.

CONTROLLING NOX IN FLUE GAS

HOW TO CONTROL NOX GENERATION IN FLUE GAS

NO_x which includes NO and NO₂, is formed during the combustion process by the oxidation of nitrogen (N₂). Nitrogen is brought in the fuel, in the waste and in the combustion air used during the incineration process.

There are 2 main methods of reducing NO_x emissions, these being combustion measures and flue gas cleaning. Combustion measures takes place when you are preventing NO_x from being generated. This is done by using a clean fuel, installing low-NO_x burners, flue-gas recirculation whereby the air used is low in oxygen, etc...All these provide a limited degree of NO_x reduction.

Flue gas cleaning is an “end-of pipe” solution. This can be done by two methods: Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR). Both methods use either urea or ammonium hydroxide as a reduction agent to react with NO_x to form nitrogen gas (N₂) and water (H₂O), both harmless to the environment.

The difference between these methods is that for SNCR the reduction agent is injected at high temperature in the furnace, while for SCR the reaction takes place at low temperature following the boiler using a catalytic ceramic.

The Thermal Treatment Facility at Marsa has a SNCR system whereby UREA is injected at the Secondary Combustion Chamber. The injection of UREA is dosed automatically depending on the following parameters:

- Temperature in the SCC needs to be above 800°C and below 1100°C.

CONTROLLING NOX IN FLUE GAS

1. The instantaneous value of NOX value needs to be above 90mg/m³ and dosing of UREA will continue until the NOX reading has decreased by 40mg/m³, hence it reads 50mg/m³.

In case that UREA is being injected but NOX is not decreasing, the HOS needs to switch off the pump and take out the nozzle and check that the nozzle is not blocked with particles/dust.

Until the problem is solved, the HOS can control the NOX manually by trying the following steps:

1. Stop waste loading until emissions go down.
2. Maintain the temperature at the Secondary Combustion Chamber (SCC) above 850°C and below 1000°C.
3. Maintain oxygen level at SCC between 5-7mmH₂O.
4. Do not switch on the vertical column air blower since this tends to increase the NOX due to flue gas turbulence.
5. Reduce the rotational speed of the Primary Combustion Chamber.

CONTROLLING HF IN FLUE GAS

HOW TO CONTROL HF GENERATION IN FLUE GAS

Hydrogen Fluoride is also called Fluoric acid, Hydrofluoride, Hydrofluoric, Fluorine monohydride. Hydrogen fluoride is corrosive, pungent odour, toxic and irritating, non-flammable and non-explosive. Hydrogen fluoride comes from the presence of F in raw materials or combustibles, such as from the combustion of fluorinated polymers (Teflon) or textiles, decomposition of CaF_2 and raw materials such as Glass. Also present in waste such as inert material, aluminium material and synthetic tissues.

The only way to control HF is to

1. Be very careful when loading waste in order not to exceed more than 300kg/hr of waste containing aluminium waste which is found a lot in pharma waste.
2. If the HF is on the increase, then stop waste loading of hazardous waste and incinerate slaughtering waste. Increase the feeding rate of Sodium Bicarbonate.
3. Ensure that the temperature in the SCC is above 850°C .
4. Reduce the rotational speed of the Primary Combustion Chamber.

CONTROLLING DUST IN FLUE GAS

HOW TO CONTROL DUST GENERATION IN FLUE GAS

Dust is produced during the combustion of waste in the PCC and due to its particulate size, it is carried along with the flue gas. As the flue gas passes through the boiler and the temperature decreases, some gases condense and solidify again forming particulates as well. However, before flue gas emits into the atmosphere, the flue gas passes through the Bag-House Filter where the dust is captured and collected in Jumbo Bags for later export for final destruction.

The Thermal Treatment Facility at Marsa is equipped with 2 dust monitoring instruments measuring in parallel. If the dust value on the emissions monitor appears on the high side, the HOS should:

1. Go to the dust instruments and read the values on the instruments display.
2. If the values are low and similar, then there is something wrong with the software. In such case inform the Plant Scientist.
3. If one of the instruments is showing a low value and the other is showing a high value, then check that the air blowers are working and inform the Plant Scientist and the electrician.
4. If both instruments are showing high values, inform the Plant Scientist.
5. The HOS can also look at the colour of the smoke from the stack to see if any dust is visible. Check also the pressure difference in the bag house filter. If there is a large change in pressure then the filter bags are damaged and the Plant may need to be switched off and bags replaced.

CONTROLLING DUST IN FLUE GAS

6. High TOC values may also result in high dust value. In such case, waste loading needs to be stopped immediately until all emissions are back to normal.

HOW TO CONTROL NH₃ GENERATION IN FLUE GAS

Ammonia is a compound of nitrogen and hydrogen with the formula NH₃. It is a colourless gas with a characteristic pungent smell.

NO_x which includes NO and NO₂, is formed during the combustion process by the oxidation of nitrogen (N₂). Nitrogen is found in the fuel, waste and in the combustion air used during the incineration process.

Currently in order to reduce NO_x, UREA is being injected at the secondary Combustion Chamber. Urea serves an important role in the metabolism of nitrogen-containing compounds by animals and is the main nitrogen-containing substance in the urine of mammals. It is a colorless, odorless solid, highly soluble in water and practically non-toxic. Urea is commonly used in Selective Non-Catalytic Reduction (SNCR) similar to the one at the TTF and Selective Catalytic Reduction (SCR) reactions to reduce the NO_x pollutants in exhaust gases from combustion from Diesel, dual fuel, and lean-burn natural gas engines. When water soluble UREA is injected in the flue gas system, the ammonia produced by the hydrolysis of the urea reacts with the nitrogen oxide emissions and is converted into nitrogen and water which are both harmless to the environment.

The System installed at the Thermal Treatment Facility at Marsa has an SNCR system whereby UREA is injected at the Secondary Combustion Chamber. The injection of UREA is dosed automatically depending on the following parameters:

- Temperature in the SCC needs to be above 850°C and below 1000°C.
- The instantaneous value of NO_x value needs to be above 90mg/m³.

Injecting excess UREA which does not react with NO_x can result in high ammonia (NH₃) in the flue gas. There could be various reasons for this occurrence such as:

- High dosing rate of UREA;
- The wrong temperature window when UREA is being injected in the flue gas;
- The waste being incinerated contains ammonia;
- The UREA nozzle is distorted or damaged with the heat;
- The instrument from which the NO_x level is obtained is not giving the correct value such as due to auto calibration. Hence UREA is being dosed when NO_x is low. Hence the excess UREA injected is causing Ammonia in the flue gas.

In order to control NH₃, one has to check the following:

- Check the UREA level in the Stainless Steel tank of the pumping unit.
- Ensure that the nozzle is atomizing UREA correctly.
- Check the MIR 9000 is giving the correct NO_x reading and is not on alarm mode or doing auto-calibration; If the instrument is on auto-calibration either switch off the pump or else change to manual mode and vary the dosing rate manually.
- Stop loading abattoir waste which may contain ammonia and load shredded wood instead;
- Reduce the rotation speed of the PCC Drum.
- Lower the dosing rate of UREA by reducing the pump stroke.
- Check the temperature rate where UREA is allowed to be injected. It could be that the set points have been varied. The range should be between 850°C and 1000°C.

Target C	250
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External Kiln Temperature

External Kiln Temperature																						Critical Z		2.51		Lower outlier	Upper outlier	Average (Max-Min T)	% RSD of average			
Time date	Line	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				
Morning PCC	Q1																					#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	-	#DIV/0!
	Q2																					#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!
	Q3																					#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!
	Q4																					#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!
	Av.	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!			
	%RSD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!			

[illegible]

Time date	Line	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!						
Night PCC	Q1																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	-	#DIV/0!	
	Q2																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!	
	Q3																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!	
	Q4																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!	
	Av.	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				
	%RSD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				

Time date	Line	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!						
Night SCC	Q1																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!						
	Q2																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	-	#DIV/0!	
	Q3																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!	
	Q4																					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0		#DIV/0!	
	Av.	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				
	%RSD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				

TTF Competence Matrix

Training Element	Facility Manager	Plant Engineer	Scientist	Head of Shift	SCADA Operator	Store keeper	Loader (Autoclave)	TTF Clerk	Bin Washer	Night Security	Inspector	Weighbridge Operator	Cleaner	Head of Maintenance	Welder/ Fitter	Electrical Technician	Assistant Fitter	Loader/ Lifter	Forklift Driver	General Hand	Loader (Blood Coagulator)	Supervisor
ISO Awareness Induction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ADM QP01 Document and Data Control Procedure	Captured through ISO Induction.																					
ADM QP02 Control of Quality Records Procedure	Captured through ISO Induction.																					
ADM QP04 Control of Non-Conforming Service Procedure	Captured through ISO Induction.																					
ADM QP05 Corrective and Preventive Action Procedure	Captured through ISO Induction.																					
ADM QP15 Complaint Management Procedure	Captured through ISO Induction.																					
ADM QP16 Certificate of Destruction	x	x	x																			
ADM QP17 Fixed Assets Registration & Transfer	x	x																				
ADM QP18 Fixed Assets Disposal	x	x																				
ADM QP21 Vehicle Registration Procedure	x	x										x										
ADM QP22 Feedback Collection Procedure	x																					
ADM QP23 Feedback Processing Procedure	x																					
ADM QP24 Registry Procedure	x																					
ADM EP01 Legal Requirements and Compliance Procedure	x																					
ADM EP02 EMS Communication Procedure	x																					
ADM EP03 Inspection Report Handling Procedure	x	x																				
ADM EP04 Aspects and Impacts Procedure	x	x																				
ADM WA01 Waste Enquiry Procedure	x	x	x																			
ADM WA02 Waste Receipt Procedure	x	x										x										
ADM WA03 Waste Inspection Procedure	x	x									x											
ADM WA06 Quarantine Procedure	x	x									x											
ADM HR01 Identification of Training Needs	x	x																				
ADM HR02 Training on Documentation	x	x																				
ADM HR03 Evaluation of Training	x	x																				
H&S Induction Training	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TTF Competence Matrix

Training Element	Facility Manager	Plant Engineer	Scientist	Head of Shift	SCADA Operator	Store keeper	Loader (Autoclave)	TTF Clerk	Bin Washer	Night Security	Inspector	Weighbridge Operator	Cleaner	Head of Maintenance	Welder/ Fitter	Electrical Technician	Assistant Fitter	Loader/ Lifter	Forklift Driver	General Hand	Loader (Blood Coagulator)	Supervisor
ADM HS01 Hazard Management	Captured through H&S Induction																					
ADM HS02 Incident Management	Captured through H&S Induction																					
ADM HS03 Lockout Tagout Procedure	x	x		x	x									x	x	x	x					
ADM HS04 Management of Chemicals	x	x	x	x	x	x								x	x	x	x					
ADM HS06 Hot Works Procedure	x	x		x										x	x	x	x					
TTF EP02 Emergency Preparedness & Response Procedure	Captured through H&S Induction																					
TTF EP03 Disposal of Hazardous Waste	x	x																				
TTF EP04 Raw Gas Monitoring	x	x	x																			
TTF EP05 Monitoring of Ground Emissions	x	x	x																			
TTF EP06 Monitoring of Air Emissions	x	x	x	x																		
TTF EP08 Monitoring of Waste Water	x	x	x																			
TTF EP09 Testing and Monitoring of Samples	x	x	x																			
TTF EP10 Implementation of Odour Monitoring Programme	x	x	x																			
TTF EP11 Monitoring of Autoclave Operational Parameters	x	x	x		x		x															
TTF QP01 TTF Waste Enquiry Procedure	x	x	x																			
TTF QP03 Waste Storage Procedure	x	x		x			x											x	x	x	x	x
TTF QP04 Incinerator Procedure	x	x		x				x	x									x				
TTF QP05 Weighbridge Transaction Documentation Handling	x	x	x					x														
TTF QP06 Cytotoxic & Cytostatic Check Procedure	x	x	x																			
TTF QP07 Waste Receipt Procedure at Night	x	x								x												
TTF SE01 Premises Security Procedure	x	x								x												
Waste Handling Training (Presentation)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Working at Heights	x	x		x	x		x		x				x	x	x	x	x	x	x	x	x	x
Forklifter License							x								x	x	x	x	x			x
Welding Course														x	x	x	x					

TTF Competence Matrix

Training Element	Facility Manager	Plant Engineer	Scientist	Head of Shift	SCADA Operator	Store keeper	Loader (Autoclave)	TTF Clerk	Bin Washer	Night Security	Inspector	Weighbridge Operator	Cleaner	Head of Maintenance	Welder/ Fitter	Electrical Technician	Assistant Fitter	Loader/ Lifter	Forklift Driver	General Hand	Loader (Blood Coagulator)	Supervisor
ERP Training	x	x		x	x									x								x
First Aid Training	x	x		x	x									x								x
Fire Fighting and Fire Wardens Training	x	x		x	x									x								x
Spill Response	x	x		x	x									x								x
Workers' Health & Safety Representative	The appointed Workers' Health & Safety Representative.																					

HOS :

Date:

Signature:

Incinerator Supervision Checklist

BOARD		Limit where applicable	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	
E	Temp. in PCC (Floor)	850-1200 °C													°C
E	Temp in SCC (Floor)	850-1100 °C													°C
E	PCC depression	4-6													mmH2o
B.Filter	ΔP of Bag House Filter *	N.A.													
G	Temp out of Economiser	190°C													°C
G	Temp of Bag Hse Filt. Inlet	N.A.													°C
UREA	UREA FEEDFLOW (black knob)	N.A.													°C
L	Boiler Pressure	N.A.													bar
L	Temp. Of Soot Blower	N.A.													°C
Thermo.	Temp of Blow Down Tank	N.A.													°C
Thermo.	Temp. of Economiser Water Inlet	N.A.													°C
RO	RO Membrane Pressure Difference	N.A.													bar
RO	Water Conductivity Prod	4000μS													μS
Boiler	Boiler Conductivity	N.A.													μS
Burner_1	Burner_1 status (Man/Aut)	N.A.													
M	Sodium Bicarb. injection	N.A.													

HOS:

Date:

Signature:

Incinerator Supervision Checklist

BOARD			Limit where applicable	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	
Switch Room	Electricity*	N.A.	kWh				Kw				Kw				kWh	
Meter	Water*	N.A.														m3
Diesel	Diesel tank_1-2-3-4-5-6** (1)	N.A.	cm		cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	ltr/hr	
	Diesel tank_1-2-3-4-5-6** (2)	N.A.	cm		cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	ltr/hr	

Remarks :

* Read at the beginning of the Shift
 ** Read manually once in each Shift

HOS :

Date:

Signature:

Incinerator Supervision Checklist

BOARD		Limit where applicable	19:00	20:00	21:00	22:00	23:00	00:00	01:00	02:00	03:00	04:00	05:00	06:00	
E	Temp. in PCC (Floor)	850-1200 °C													°C
E	Temp in SCC (Floor)	850-1100 °C													°C
E	PCC depression	N.A.													mmH2o
B.Filter	ΔP of Bag House Filter *	N.A.													
G	Temp out of Economiser	190°C													°C
G	Temp of Bag Hse Filt. Inlet	N.A.													°C
UREA	UREA FEEDFLOW (black knob)	N.A.													
L	Boiler Pressure	N.A.													bar
L	Temp. Of Soot Blower	N.A.													°C
Thermo.	Temp of Blow Down Tank	N.A.													°C
Thermo.	Temp of Economiser Water Inlet	N.A.													°C
RO	RO Membrane Pressure Difference	N.A.													bar
RO	Water Conductivity Prod	4000μS													μS
Boiler	Boiler Conductivity	N.A.													μS
Burner_1	Burner_1 status (Man/Aut)	N.A.													
M	Sodium Bicarb. injection	N.A.													

HOS: _____

Date: _____

Signature: _____

Incinerator Supervision Checklist

BOARD			19:00	20:00	21:00	22:00	23:00	00:00	01:00	02:00	03:00	04:00	05:00	06:00		
Switch Room	Electricity**	N.A.	kWh				Kw				Kw				kWh	
Meter	Water**	N.A.														m3
Diesel	Diesel tank_1-2-3-4-5-6*** (1)	N.A.	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	ltr/hr	
	Diesel tank_1-2-3-4-5-6*** (2)	N.A.	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	ltr/hr	

* Read every 2 hours

** Read at the beginning of the Shift

*** Read manually once in each Shift

Remarks :

Waste Mix to be Incinerated

Time	Type of Material				
07:00	H+S	I	W+S	H+S	I
08:00	W+S	H+S	I	W+S	H+S
09:00	I	W+S	H+S	I	W+S
10:00	H+S	I	W+S	H+S	I
11:00	W+S	H+S	I	W+S	H+S
12:00	I	W+S	H+S	I	W+S

H+S	≡	Hospital + Screw
I	≡	Intestines
W+S	≡	Wood + Screw
S	≡	Screw
W	≡	Wood
H	≡	Hospital

Waste Mix to be Incinerated

Time	Type of Material				
13:00	H+S	I	W+S	H+S	I
14:00	W+S	H+S	I	W+S	H+S
15:00	I	W+S	H+S	I	W+S
16:00	H+S	I	W+S	H+S	I
17:00	W+S	H+S	I	W+S	H+S
18:00	I	W+S	H+S	I	W+S

H+S	≡	Hospital + Screw
I	≡	Intestines
W+S	≡	Wood + Screw
S	≡	Screw
W	≡	Wood
H	≡	Hospital

Waste Mix to be Incinerated

Time	Type of Material				
19:00	H+S	I	W+S	H+S	I
20:00	W+S	H+S	I	W+S	H+S
21:00	I	W+S	H+S	I	W+S
22:00	H+S	I	W+S	H+S	I
23:00	W+S	H+S	I	W+S	H+S
00:00	I	W+S	H+S	I	W+S

H+S	≡	Hospital + Screw
I	≡	Intestines
W+S	≡	Wood + Screw
S	≡	Screw
W	≡	Wood
H	≡	Hospital

Waste Mix to be Incinerated

Time	Type of Material				
01:00	H+S	I	W+S	H+S	I
02:00	W+S	H+S	I	W+S	H+S
03:00	I	W+S	H+S	I	W+S
04:00	H+S	I	W+S	H+S	I
05:00	W+S	H+S	I	W+S	H+S
06:00	I	W+S	H+S	I	W+S

H+S	≡	Hospital + Screw
I	≡	Intestines
W+S	≡	Wood + Screw
S	≡	Screw
W	≡	Wood
H	≡	Hospital

Signature- Head of Shift: _____

External kiln temperature sheet

Date: _____

Time: _____

Time: _____

	PCC			
	Q1	Q2	Q3	Q4
L1				
L2				
L3				
L4				
L5				
L6				
L7				
L8				
L9				
L10				
L11				
L12				
L13				
L14				
L15				
L16				
L17				
L18				
L19				
L20				

	SCC	
	Q1	Q2
L1		
L2		
L3		
L4		
L5		
L6		
L7		
L8		
L9		
L10		
L11		
L12		
L13		
L14		
L15		
L16		
L17		
L18		
L19		
L20		

All temperatures should be less than 200°C. If a temperature exceeds 200°C, please inform the Facility Manager immediately.

Head of Shift signature: _____

TTF DAILY REPORT									
DATE (dd/mm/yy)	16-02-21				Shift				
HOS in charge									
Diesel Consumed/Litres	0		Fuel: Waste Ratio (Ltrs/T)			0			
Qtn. of 1/2 hr Emissions exceedances	CO	HCL	THC	HF	NO _x	SO ₂	Dust	NH ₃	
	0	0	0	0	0	0	0	0	0
Justification for Exceedance									
Emissions									
Quantity of treated liquid in coagulator / Litres	0		Enter value of 0 if N/A						
Waste Incinerated During Shift (in Kgs)									
Abattoir Waste @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Clinical Waste @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Pharma Waste @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Paint @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Plastic @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Wood @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Waste Oil @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Oily Rags @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Egg Shells @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Bone Meal @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Tallow @ End of Shift (in Kgs)	0		Enter value of 0 if N/A						
Other Waste @ End of Shift	0		Enter value of 0 if N/A						
Total	0								

	DESCRIPTION OF WORK CARRIED OUT / REPORTS OF ANY FAULTS NOTICED

<i>Transfer of bags form the store</i>	<i>Quantity</i>	<i>Comments (If applicable)</i>
Sodium-Bicarbonate	0	
Activated Carbon	0	

<i>Check of Duties</i>		<i>Tick</i>		<i>Tick</i>	
PCC outside Temp	Done	<input type="checkbox"/>	N/Done	<input type="checkbox"/>	Mark with an (X) in the appropriate box
SCC outside Temp	Done	<input type="checkbox"/>	N/Done	<input type="checkbox"/>	
Water Reservoir	Done	<input type="checkbox"/>	N/Done	<input type="checkbox"/>	
Bottom Ash container check	Done	<input type="checkbox"/>	N/Done	<input type="checkbox"/>	
Fire fighting reservoir level check	Done	<input type="checkbox"/>	N/Done	<input type="checkbox"/>	

<i>Remaining Bins</i>	<i>Quantity</i>	<i>Comments (If applicable)</i>
No. of bins in B&T fridge	0%	
No. of abattoir bins in Unloading area	0	
No. of clinical bins in Unloading area	0	
Total Bins in Unloading Area	0	
Qty of Fallen Animals	0	Enter value of 0 if N/A

Injury on Duty Reports	0	
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THERMAL TREATMENT FACILITY MARSA
Emissions Exceedance Report

Date:	
Pollutant:	Reason:
Time:	
1/2 hr average (mg/Nm3):	
Measures Taken:	

Pollutant:	Reason:
Time:	
1/2 hr average (mg/Nm3):	
Measures Taken:	

Pollutant:	Reason:
Time:	
1/2 hr average (mg/Nm3):	
Measures Taken:	

Pollutant:	Reason:
Time:	
1/2 hr average (mg/Nm3):	
Measures Taken:	

Name and Signature: _____

LABORATORY REPORT

- Analysis of Plant Water samples at Thermal Treatment Facility (TTF) -

Report Reference Number: [Click or tap here to enter text.](#)

Sample Reference Number: [Click or tap here to enter text.](#)

Date of Sample Collection: [Click or tap to enter a date.](#)

Date of Sample Analysis: [Click or tap to enter a date.](#)

Analysis SOP: [Click or tap here to enter text.](#)

TTF Plant Status: ☐ Normal Operation / ☐ Maintenance

Limits for Plant Water – TTF							
as suggested by Chemserv s.r.l. plant water expert, whereby also making reference to UNI EN 12953-10:2005 (*) where applicable							
Parameter		Filtered Water	De-mineralised	RO Reservoir	Degasser	Condensate	Boiler
Total Hardness mg/L CaCO ₃	Data		Text	Text	Text		Preferably low
	Limit		<0.5	<0.5	<5* (At operating pressure <1 bar)		
Iron mg/L Fe	Data		Text	Text	Text		Preferably low
	Limit		Expected value: <0.1	Expected value: <0.1	<0.3*		
Composite Alkalinity mg/L CaCO ₃	Data				Text		Text
	Limit				20-40 (P-alkalinity)		<750* (P-alkalinity)
Sulphite mg/L SO ₃ ²⁻	Data				Text		Text
	Limit				10-20 (by proper BT1040 dosing)		30-60
Conductivity µS/cm	Data		RO meter: Lab meter:	RO meter: Lab meter:		Text	Text
	Limit	(A)	<3-5% than A Rated: _____	<3-5% than A Rated: _____		<20	<1500*
pH	Data		Text	Text	Text	Text	Text
	Limit		Expected value: 5.5-7.0	Expected value: 5.5-7.0	>9.2*	>8.2	10.5-12*

Additional Comments:

Analysed by: [Click or tap here to enter text.](#)

Date of Reporting: [Click to enter a date.](#)

Signature: _____

Autoclave Supervision Checklist

Operator on Duty :

Date:

Signature:

Scrubber: Chemical Tanks Level

(check once daily)

Level of Sulphuric Acid

☐ Low

☐ Medium

☐ High

Level of Caustic Soda

☐ Low

☐ Medium

☐ High

Level of Sodium Hypochloride

☐ Low

☐ Medium

☐ High

Decaners

(check once daily)

CAT 1 Decanter Level

☐ Low

☐ Medium

☐ High

CAT 1 Decanter Temperature

 °C

CAT 2 Decanter Level

☐ Low

☐ Medium

☐ High

CAT 2 Decanter Temperature

 °C

Plant Checks

CAT 1 Cooked product blowdown

☐ After Each Cycle

CAT 1 Press fat blowdown

☐ After Each Cycle

CAT 2 Cooked product blowdown

☐ After Each Cycle

CAT 2 Press fat blowdown

☐ After Each Cycle

CAT 1 Rendered waste compartment cleaned

☐ After Each Shift

CAT 2 Rendered waste compartment cleaned

☐ After Each Shift

All Doors Closed

☐ Morning

☐ Afternoon

Boiler

(check twice daily)

Boiler Pressure

Morning: (bar)

Afternoon: (bar)

Fuel Consumption

Note: One Full Cylinder contains 5,000 Ltrs of LPG.

Amount of fuel at start of shift

(% of fuel in tank):

Time:

Amount of fuel at end of shift

(% of fuel in tank):

Time:

Fuel Consumption (%):

Autoclave Operation Parameters*(check for each cooking cycle)*

Heating Temperature CAT 1 (°C) :
(Typical Value 100 °C)

Heating Duration CAT 1 (min) :
(Typical Value 95 min)

Sterilization Temperature CAT 1 (°C) :
(Typical Value 110 °C)

Sterilization Pressure CAT 1 (dBar) :
(Typical Range 9 - 10 dBar)

Sterilization Duration CAT 1 (min) :
(Typical Value 55 min)

Drying Temperature CAT 1 (°C) :
(Typical Value 120 °C)

Drying Duration CAT 1 (min) :
(Typical Value 13 min)

Heating Temp. CAT 2/ 3 (°C) :
(Typical Value 100 °C)

Heating Duration CAT 2/ 3 (min) :
(Typical Value 95 min)

Steriliz. Temperature CAT 2/ 3 (°C) :
(Typical Value 110 °C)

Steriliz. Pressure CAT 2/ 3 (dBar) :
(Typical Range 9 - 10 dBar)

Steriliz. Duration CAT 2/ 3 (min) :
(Typical Value 55 min)

Drying Temperature CAT 2/ 3 (°C) :
(Typical Value 120 °C)

Drying Duration CAT 2/ 3 (min) :
(Typical Value 13 min)

Odours *(check once daily)*

Where there any odours outside the Autoclave?

Y / N

If yes, specify area: _____

Silos *(check once daily)***Meal Silos**

CAT1 meal silo _____ %

CAT2 meal silo 1 _____ %

CAT2 meal silo 2 _____ %

CAT2 meal silo 3 _____ %

CAT2 meal silo 4 _____ %

Tallow Silos

CAT1 tallow silo _____ %

CAT2 tallow silo 1 _____ %

CAT2 tallow silo 2 _____ %

Mixed tallow silo 3 _____ %

Fridges *(check once daily)*

CAT 1 Fridge Temperature [less or equal to 7°C] : _____ °C

CAT 2 Fridge Temperature [less or equal to 7°C] : _____ °C

Refilling of Fuel Tanks *(to be filled up only when refilling of tanks is performed)*

Time of Refill:

Amount of fuel before refill
(% of fuel in tank):

Amount of fuel after refill
(% of fuel in tank):

Fuel Added:

Supplier:

Delivery Note
No. Supplier:

Remarks:

LABORATORY REPORT

- Analysis of Autoclave Boiler water, Feed Water and Softened Water samples -

Report Reference Number: [Click or tap here to enter text.](#)

Sample Reference Number: [Click or tap here to enter text.](#)

Date of Sample Collection: [Click or tap to enter a date.](#)

Date of Sample Analysis: [Click or tap to enter a date.](#)

Analysis SOP: [Click or tap here to enter text.](#)

TTF Plant Status: ☐ Normal Operation / ☐ Maintenance

Limits for Plant Water – Autoclave

as suggested by Chemserv s.r.l. plant water expert, whereby also making reference to UNI EN 12953-10:2005 (*) where applicable

Parameter	Softened Water		Feed Water (condensate + softened)		Boiler Water	
	Data	Limit	Data	Limit	Data	Limit
Total Hardness (Ca + Mg) mg/L CaCO ₃	Text	10 mg/L CaCO ₃ is acceptable if condensate recovery is >90%	Text	<1*		
Iron mg/L Fe	Text	<0.2 mg/L Fe in municipal water	Text	<0.3*		
Oily substance mg/L			Text	Text		
Composite Alkalinity mg/L CaCO ₃			Text	Text	Text	<750* (as P-alkalinity)
pH			Text	Text	Text	10.5-12.0*
Sulphite ppm SO ₃ ²⁻			Text	Text	Text	30-60
Conductivity μS/cm					Text	<6000*
Silica mg/L SiO ₂					Text	<160*
Phosphate mg/L PO ₄ ³⁻					Text	<30*

Additional Comments:

Analysed by: [Click or tap here to enter text.](#)

Date of Reporting: [Click to enter a date.](#)

Signature: _____

Officer on Duty:

Date:

Signature:

U-DAF				
	Spec	Morning	Mid-day	Evening
Alarms [Yes / No]				
Incoming Air Pressure (in bar)	~5.5 - 6.0			
Air Pressure (in bar)	~4.0			
Air Flow (in L/min)	~1.5 - 3.0			
Water Flow (in m³/hr)	~3.5			

Biological Reactor				
	Spec	Morning	Mid-day	Evening
Oxygen Content (in mg/L)	~2 - 9			

UV System				
		Morning	Mid-day	Evening
Alarms [Yes / No]				
Working Time (in hours)				

Dosing Pump				
		Morning	Mid-day	Evening
PH				
Dosing (in %)				

Chemicals				
		Morning	Mid-day	Evening
Poly-Aluminium Chloride [Low / Medium / High]				
Sodium Hydroxide [Low / Medium / High]				
Sodium Hypochlorite [Low / Medium / High]				
Cationic Polymer [Low / Medium / High]				

Remarks:

Annex XVII: Acceptable Waste Streams

Annex XVII – Waste streams that are acceptable at the Thermal Treatment Facility

This annex is highlighting the EWC codes permitted at the TTF under the current IP 0004/07/B, Schedule 3 according to a number of categories, namely:

Yellow : waste streams containing a high liquid contents (aqueous or organic). These can be accepted in small quantities at the discretion of Scientist/Management, and at specified volumes per week. This excludes solid sludges.

Red: Namely paints containing high level of chromium. These are not accepted.

Blue: including EWC 13 01 01* hydraulic oils, containing PCBs; and EWC 13 03 01* insulating or heat transmission oils containing PCBs are accepted in limited quantities.

Schedule 3

List of wastes authorised to be accepted

NON-HAZARDOUS WASTE

02 01 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing

02 01 02 animal-tissue waste

02 01 03 plant tissue waste

02 01 06 animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site

02 01 07 waste from forestry

02 01 09 agrochemical waste other than those mentioned in 02 01 08*

02 01 99 Waste not otherwise specified

02 02 wastes from the preparation and processing of meat, fish and other foods of animal origin

02 02 02 animal-tissue waste

02 02 03 materials unsuitable for consumption or processing

02 02 99 waste not otherwise specified

02 03 wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing; conserve production; yeast and yeast extract production, molasses preparation and fermentation

02 03 04 materials unsuitable for consumption or processing

02 03 99 waste not otherwise specified

02 04 wastes from sugar processing

02 04 99 waste not otherwise specified

02 05 wastes from the dairy products industry

02 05 01 materials unsuitable for consumption or processing

02 05 99 waste not otherwise specified

02 06 wastes from the baking and confectionary industry

02 06 99 waste not otherwise specified

02 07 wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cacao)

02 07 99 waste not otherwise specified

03 01 wastes from wood processing and the production of panels and furniture

03 01 05 sawdust, shavings, cutting, wood, particle board and veneer other than those mentioned in 03 01 04

04 02 wastes from the textile industry

04 02 15 waste from finishing other than those mentioned in 04 02 14

04 02 17 dyestuffs and pigments other than those mentioned in 04 02 16

04 02 20 sludges from on-site effluent treatment other than those mentioned in 04 02 19

06 05 sludges from on-site effluent treatment

06 05 03 sludges from on-site effluent treatment other than those mentioned in 06 05 02

07 01 wastes from the MFSU of basic organic chemicals

07 01 12 sludges from on-site effluent treatment other than those mentioned in 07 01 11

07 02 wastes from the MFSU of plastics, synthetic rubber and man-made fibres

07 02 12 sludges from on-site effluent treatment other than those mentioned in 07 02 11

07 02 15 wastes from additives other than those mentioned in 07 02 14

07 02 17 waste containing silicones other than those mentioned in 07 02 16

07 03 wastes from the MFSU of organic dyes and pigments (except 06 11)

07 03 12 sludges from on-site effluent treatment other than those mentioned in 07 03 11

07 04 wastes from the MFSU of organic plant protection products (except 02 01 08 and 02 01 09), wood preserving agents (except 03 02) and other biocides

07 04 12 sludges from on-site effluent treatment other than those mentioned in 07 04 11

07 05 wastes from the MFSU of pharmaceuticals

07 05 12 sludges from on-site effluent treatment other than those mentioned in 07 05 11

07 05 14 solid wastes other than those mentioned in 07 05 13

07 06 wastes from the MFSU of fats, grease, soaps, detergents, disinfectants and cosmetics

07 06 12 sludges from on-site effluent treatment other than those mentioned in 07 06 11

07 07 wastes from the MFSU of fine chemicals and chemical products not otherwise specified

07 07 12 sludges from on-site effluent treatment other than those mentioned in 07 07 11

08 01 wastes from MFSU and removal of paint and varnish

08 01 12 waste paint and varnish other than those mentioned in 08 01 11

08 01 14 sludges from paint or varnish other than those mentioned in 08 01 13

08 01 16 aqueous sludges containing paint or varnish other than those mentioned in 08 01 15

08 01 18 waste from paint or varnish removal other than those mentioned in 08 01 17

08 01 20 aqueous suspensions containing paint or varnish other than those mentioned in 08 01 19

08 03 wastes from MFSU of printing inks

08 03 07 aqueous sludges containing ink

08 03 13 waste ink other than those mentioned in 08 03 12

08 03 15 ink sludges other than those mentioned in 08 03 14

08 03 18 waste printing toner other than those mentioned in 08 03 17

08 04 wastes from MFSU of adhesives and sealants (including waterproofing products)

08 04 10 waste adhesives and sealants other than those mentioned in 08 04 09

08 04 12 adhesive and sealant sludges other than those mentioned in 08 04 11

08 04 14 aqueous sludges containing adhesives or sealants other than those mentioned in 08 04 13

08 04 16 aqueous liquid waste containing adhesives or sealants other than those mentioned in 08 04 15

12 01 wastes from shaping and physical and mechanical surface treatment of metals and plastics

12 01 15 machining sludges other than those mentioned in 12 01 14

12 01 17 waste blasting material other than those mentioned in 12 01 16

12 01 21 spent grinding bodies and grinding materials other than those mentioned in 12 01 20

15 01 packaging (including separately collected municipal packaging waste)

15 01 01 paper and cardboard packaging

15 01 03 wooden packaging

15 02 absorbents, filter materials, wiping cloths and protective clothing

15 02 03 absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing other than those mentioned in 15 02 02

16 01 end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)

16 01 15 antifreeze fluids other than those mentioned in 16 01 14

16 03 off-specification batches and unused products

16 03 04 inorganic wastes other than those mentioned in 16 03 03*

16 03 06 organic wastes other than those mentioned in 16 03 05

16 05 gases in pressure containers and discarded chemicals

16 05 09 discarded chemicals other than those mentioned in 16 05 06*, 16 05 07*, or 16 05 08*

16 10 aqueous liquid wastes destined for off-site treatment

16 10 02 aqueous liquid wastes other than those mentioned in 16 10 01

16 10 04 aqueous concentrates other than those mentioned in 16 10 03

16 11 waste linings and refractories

16 11 02 carbon-based linings and refractories from metallurgical processes other than those mentioned in 16 11 01

17 02 wood, glass and plastic

17 02 01 wood

18 01 wastes from natal care, diagnosis, treatment or prevention of disease in humans

18 01 01 sharps (except 18 01 03)

18 01 02 body parts and organs including blood bags and blood preserves (except 18 01 03)

- 18 01 04 waste whose collection and disposal is not subject to special requirements in order to prevent infection (e.g. dressings, plaster casts, linen, disposable clothing, diapers)
- 18 01 07 chemicals other than those mentioned in 18 01 06
- 18 01 09 medicines other than those mentioned in 18 01 08
- 18 02 wastes from research, diagnosis, treatment or prevention of disease involving animals**
- 18 02 01 sharps (except 18 02 02)
- 18 02 03 waste whose collection and disposal is not subject to special requirements in order to prevent infection
- 18 02 06 chemicals other than those mentioned in 18 02 05
- 18 02 08 medicines other than those mentioned in 18 02 07
- 19 08 wastes from waste water treatment plants not otherwise specified**
- 19 08 05 sludges from treatment of urban waste water
- 19 08 09 grease and oil mixture from oil/water separation containing only edible oil and fats
- 19 08 12 sludges from biological treatment of industrial waste water other than those mentioned in 19 08 11
- 19 08 14 sludges from other treatment of industrial waste water other than those mentioned in 19 08 13
- 19 09 wastes from the preparation of drinking water or water for human consumption or water for industrial use**
- 19 09 04 spent activated carbon
- 19 11 wastes from oil regeneration**
- 19 11 06 sludges from on-site effluent treatment other than those mentioned in 19 11 05
- 19 12 wastes from the mechanical treatment of waste (e.g. sorting, crushing, compacting, pelletising) not otherwise specified**
- 19 12 01 paper and cardboard
- 19 12 04 plastic and rubber
- 19 12 07 wood other than that mentioned in 19 12 06
- 19 12 08 textiles
- 19 12 10 combustible waste (refuse derived fuel)
- 19 12 12 other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11
- 19 13 wastes from soil and groundwater remediation**
- 19 13 04 sludges from soil remediation other than those mentioned in 19 13 03
- 19 13 06 sludges from groundwater remediation other than those mentioned in 19 13 05
- 19 13 08 aqueous liquid wastes and aqueous concentrates from groundwater remediation other than those mentioned in 19 13 07
- 20 01 separately collected fractions (except 15 01)**
- 20 01 10 clothes
- 20 01 11 textiles
- 20 01 25 edible oil and fat
- 20 01 28 paints, inks, adhesives and resins other than those mentioned in 20 01 27
- 20 01 30 detergents other than those mentioned in 20 01 29*
- 20 01 32 medicines other than those mentioned in 20 01 31
- 20 01 38 wood other than that mentioned in 20 01 37

HAZARDOUS WASTE

- 02 01 wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing**
- 02 01 08* agrochemical waste containing dangerous substances
- 03 01 wastes from wood processing and the production of panels and furniture**
- 03 01 04* sawdust, shavings, cutting, wood, particle board and veneer containing dangerous substances
- 03 02 wood preservation wastes**
- 03 02 01* non-halogenated organic wood preservatives
- 03 02 03* organometallic wood preservatives
- 03 02 05* other wood preservatives containing dangerous substances
- 04 02 wastes from the textile industry**

- 04 02 14* waste from finishing containing organic solvents
- 04 02 16* dyestuffs and pigments containing dangerous substances
- 04 02 19* sludges from on-site effluent treatment containing dangerous substances
- 05 01 wastes from petroleum refining**
- 05 01 05* oil spills
- 06 05 sludges from on-site effluent treatment**
- 06 05 02* sludges from on-site effluent treatment containing dangerous substances
- 06 08 waste from the MFSU of silicon and silicon derivatives**
- 06 08 02* waste containing dangerous silicones
- 06 13 wastes from inorganic chemical processes**
- 06 13 02* spent activated carbon (except 06 07 02)
- 06 10 05* soot
- 07 01 wastes from the manufacture, formulation, supply and use (MFSU) of basic organic chemicals**
- 07 01 01* aqueous washing liquids and mother liquors
- 07 01 04* other organic solvents, washing liquids and mother liquors
- 07 01 08* other still bottoms and reaction residues
- 07 01 10* other filter cakes and spent absorbents
- 07 01 11* sludges from on-site effluent treatment containing dangerous substances
- 07 02 wastes from the MFSU of plastics, synthetic rubber and man-made fibres**
- 07 02 01* aqueous washing liquids and mother liquors
- 07 02 04* other organic solvents, washing liquids and mother liquors
- 07 02 08* other still bottoms and reaction residues
- 07 02 10* other filter cakes and spent absorbents
- 07 02 11* sludges from on-site effluent treatment containing dangerous substances
- 07 02 14* wastes from additives other than those containing dangerous substances
- 07 02 16* waste containing dangerous silicones
- 07 03 wastes from the MFSU of organic dyes and pigments (except 06 11)**
- 07 03 01* aqueous washing liquids and mother liquors
- 07 03 04* other organic solvents, washing liquids and mother liquors
- 07 03 08* other still bottoms and reaction residues
- 07 03 10* other filter cakes, spent absorbents
- 07 03 11* sludges from on-site effluent treatment containing dangerous substances
- 07 04 wastes from the MFSU of organic plant protection products (except 02 01 08 and 02 01 09), wood preserving agents (except 03 02) and other biocides**
- 07 04 01* aqueous washing liquids and mother liquors
- 07 04 04* other organic solvents, washing liquids and mother liquors
- 07 04 08* other still bottoms and reaction residues
- 07 04 10* other filter cakes and spent absorbents
- 07 04 11* sludges from on-site effluent treatment containing dangerous substances
- 07 04 13* solid wastes containing dangerous substances
- 07 05 wastes from the MFSU of pharmaceuticals**
- 07 05 01* aqueous washing liquids and mother liquors
- 07 05 04* other organic solvents, washing liquids and mother liquors
- 07 05 08* other still bottoms and reaction residues
- 07 05 10* other filter cakes and spent absorbents
- 07 05 11* sludges from on-site effluent treatment containing dangerous substances
- 07 05 13* solid wastes containing dangerous substances
- 07 06 wastes from the MFSU of fats, grease, soaps, detergents, disinfectants and cosmetics**
- 07 06 01* aqueous washing liquids and mother liquors
- 07 06 04* other organic solvents, washing liquids and mother liquors
- 07 06 08* other still bottoms and reaction residues
- 07 06 10* other filter cakes and spent absorbents
- 07 06 11* sludges from on-site effluent treatment containing dangerous substances
- 07 07 wastes from the MFSU of fine chemicals and chemical products not otherwise specified**
- 07 07 01* aqueous washing liquids and mother liquors
- 07 07 04* other organic solvents, washing liquids and mother liquors
- 07 07 08* other still bottoms and reaction residues

- 07 07 10* other filter cakes and spent absorbents
- 07 07 11* sludges from on-site effluent treatment containing dangerous substances
- 08 01 wastes from MFSU and removal of paint and varnish**
- 08 01 11* waste paint and varnish containing organic solvents or other dangerous substances
- 08 01 13* sludges from paint or varnish containing organic solvents or other dangerous substances
- 08 01 15* aqueous sludges containing paint or varnish containing organic solvents or other dangerous substances
- 08 01 17* waste from paint or varnish removal containing organic solvents or other dangerous substances
- 08 01 19 * aqueous suspensions containing paint or varnish containing organic solvents or other dangerous substances
- 08 01 21* waste paint or varnish remover
- 08 03 wastes from MFSU of printing inks**
- 08 03 12* waste ink containing dangerous substances
- 08 03 14* ink sludges containing dangerous substances
- 08 03 16* waste etching solutions
- 08 03 17* waste printing toner containing dangerous substances
- 08 03 19* disperse oil
- 08 04 wastes from MFSU of adhesives and sealants (including waterproofing products)**
- 08 04 09* waste adhesives and sealants containing organic solvents or other dangerous substances
- 08 04 11* adhesive and sealant sludges containing organic solvents or other dangerous substances
- 08 04 13* aqueous sludges containing adhesives or sealants containing organic solvents or other dangerous substances
- 08 04 15* aqueous liquid waste containing adhesives or sealants with organic solvents or other dangerous substances
- 08 04 17* rosin oil
- 08 05 wastes not otherwise specified in 08**
- 08 05 01* waste isocyanates
- 11 03 sludges and solids from tempering processes**
- 11 03 02* other wastes
- 12 01 wastes from shaping and physical and mechanical surface treatment of metals and plastics**
- 12 01 07* mineral-based machining oils free of halogens (except emulsions and solutions)
- 12 01 09* machining emulsions and solutions free of halogens
- 12 01 10* synthetic machining oils
- 12 01 12* spent waxes and fats
- 12 01 14* machining sludges containing dangerous substances
- 12 01 16* waste blasting material containing dangerous substances
- 12 01 18* metal sludge (grinding, honing and lapping solution) containing oil
- 12 01 19* readily biodegradable machining oil
- 12 01 20* spent grinding bodies and grinding materials containing oil
- 13 01 waste hydraulic oils**
- 13 01 01* hydraulic oils, containing PCBs
- 13 01 10* mineral-based non-chlorinated hydraulic oils
- 13 01 11* synthetic hydraulic oils
- 13 01 12* readily biodegradable hydraulic oils
- 13 01 13* other hydraulic oils
- 13 02 waste engine, gear and lubricating oils**
- 13 02 05* mineral-based non-chlorinated engine, gear and lubricating oils
- 13 02 06* synthetic engine, gear and lubricating oils
- 13 02 07* readily biodegradable insulating and heat transmission oils
- 13 02 08* other engine, gear and lubricating oils
- 13 03 waste insulating and heat transmission oils**
- 13 03 01* insulating or heat transmission oils containing PCBs
- 13 03 07* mineral-based non-chlorinated insulating and heat transmission oils
- 13 03 08* synthetic insulating and heat transmission oils

- 13 03 09* readily biodegradable insulating and heat transmission oils
- 13 03 10* other insulating and heat transmission oils
- 13 04 bilge oils**
 - 13 04 01* bilge oils from inland navigation
 - 13 04 02* bilge oils from jetty sewers
 - 13 04 03* bilge oils from other navigation
- 13 05 oil/water separator contents**
 - 13 05 01* solids from grit chambers and oil/water separators
 - 13 05 02* sludges from oil/water separators
 - 13 05 03* interceptor sludges
 - 13 05 06* oil from oil / water separators
 - 13 05 07* oily water from oil / water separators
 - 13 05 08* mixtures of wastes from grit chambers and oil / water separators
- 13 07 wastes of liquid fuels**
 - 13 07 01* fuel oil and diesel
 - 13 07 02* petrol
 - 13 07 03* other fuels (including mixtures)
- 13 08 oil wastes not otherwise specified**
 - 13 08 01* desalter sludges or emulsions
 - 13 08 02* other emulsions
 - 13 08 99* wastes not otherwise specified
- 15 01 packaging (including separately collected municipal packaging waste)**
 - 15 01 10* packaging containing residues of or contaminated by dangerous substances
- 15 02 absorbents, filter materials, wiping cloths and protective clothing**
 - 15 02 02* absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances
- 16 01 end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)**
 - 16 01 07* oil filters
 - 16 01 13* brake fluids
 - 16 01 14* antifreeze fluids containing dangerous substances
 - 16 01 21* hazardous components other than those mentioned in 16 01 07 to 16 01 11 and 16 01 13 and 16 01 14
- 16 03 off-specification batches and unused products**
 - 16 03 03* inorganic wastes containing dangerous substances
 - 16 03 05* organic wastes containing dangerous substances
- 16 05 gases in pressure containers and discarded chemicals**
 - 16 05 06* laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals
 - 16 05 07* discarded inorganic chemicals consisting of or containing dangerous substances
 - 16 05 08* discarded organic chemicals consisting of or containing dangerous substances
- 16 07 wastes from transport tank, storage tank and barrel cleaning (except 05 and 13)**
 - 16 07 08* wastes containing oil
 - 16 07 09* waste containing other dangerous substances
- 16 10 aqueous liquid wastes destined for off-site treatment**
 - 16 10 01* aqueous liquid wastes containing dangerous substances
 - 16 10 03* aqueous concentrates containing dangerous substances
- 17 02 wood, glass and plastic**
 - 17 02 04* glass, plastic and wood containing or contaminated with dangerous substances
- 18 01 wastes from natal care, diagnosis, treatment or prevention of disease in humans**
 - 18 01 03* waste whose collection and disposal is subject to special requirements in order to prevent infection
 - 18 01 06* chemicals consisting of or containing dangerous substances
- 18 02 wastes from research, diagnosis, treatment or prevention of disease involving animals**
 - 18 02 02* waste whose collection and disposal is subject to special requirements in order to prevent infection

- 18 02 05* chemicals consisting of or containing dangerous substances
- 19 01 wastes from incineration or pyrolysis of waste**
- 19 01 10* spent activated carbon from flue-gas treatment
- 19 02 wastes from physico/chemical treatments of industrial waste (including dechromatation, decyanidation and neutralisation)**
- 19 02 07* oil and concentrates from separation
- 19 02 11* other wastes containing dangerous substances
- 19 08 wastes from waste water treatment plants not otherwise specified**
- 19 08 07* solutions and sludges from regeneration of ion exchangers
- 19 08 09* grease and oil mixture from oil/water separation containing only edible oil and fats (not hazardous)
- 19 08 10* grease and oil mixture from oil/water separation other than those mentioned in 19 08 09
- 19 08 11* sludges containing dangerous substances from biological treatment of industrial waste water
- 19 08 13* sludges containing dangerous substances from other treatment of industrial waste water
- 19 11 wastes from oil regeneration**
- 19 11 01* spent filter clays
- 19 11 02* acid tars
- 19 11 03* aqueous liquid wastes
- 19 11 04* wastes from cleaning of fuel with bases
- 19 11 05* sludges from on-site effluent treatment containing dangerous substances
- 19 12 wastes from the mechanical treatment of waste (e.g. sorting, crushing, compacting, pelletising) not otherwise specified**
- 19 12 06* wood containing dangerous substances
- 19 12 11* other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances
- 19 13 wastes from soil and groundwater remediation**
- 19 13 03* sludges from soil remediation containing dangerous substances
- 19 13 05* sludges from groundwater remediation containing dangerous substances
- 19 13 07* aqueous liquid wastes and aqueous concentrates from groundwater remediation containing dangerous substances
- 20 01 separately collected fractions (except 15 01)**
- 20 01 13* solvents
- 20 01 14* acids (organic only)
- 20 01 15* alkalines (organic only)
- 20 01 17* photochemicals
- 20 01 19* pesticides
- 20 01 26* oil and fat other than those mentioned in 20 01 25
- 20 01 27* paints, inks, adhesives and resins containing dangerous substances
- 20 01 29* Detergents containing dangerous substances
- 20 01 37* wood containing dangerous substance

Annex XVIII: Scrubber Control Details

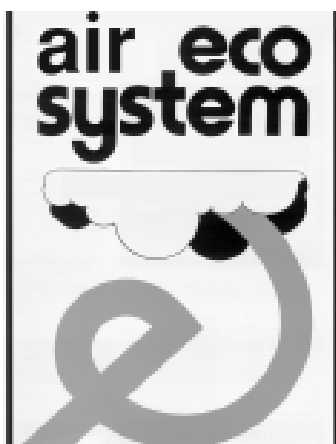


AIR ECOSYSTEM SRL

USE, MAINTENANCE AND ASSEMBLY MANUAL

Air Ecosystem S.r.l.

Address: Via F.lli CERVI 1/D - 20063 CERNUSCO S.N. (MI) Tel.02/9273131 Fax.02/92731329



USE, MAINTENANCE AND ASSEMBLY MANUAL

HYDROCOL HY 20

AGRICARNITEC S.r.l. - MALTA

JOB 1558



AIR ECOSYSTEM SRL

USE, MAINTENANCE AND ASSEMBLY MANUAL

DECLARATION OF CONFORMITY

DICHIARAZIONE DI CONFORMITA'

N° 1558

(ACCORDING TO MACHINES DIRECTIVE 89/392/EEC)

(SECONDO DIRETTIVA MACCHINE 89/392/CEE)

MACHINE

APPARECCHIATURA

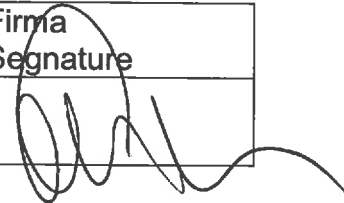
MODELLO/MODEL	HYDROCOL
TIPO/TYPE	HY 20
ANNO DI COSTRUZIONE/YEAR OF CONSTRUCTION	2015

CLIENTE/CUSTOMER	AGRICARNITEC S.r.l.
(as per the CE-sticker put on the machine) (come da targhetta CE presente sull'apparecchio)	

DICHIARAZIONE/DECLARATION

As signers of the present declaration, we declare under our own exclusive responsibility that the above mentioned machine is made in conformity with the council directive 89/392/EEC.

Il firmatario della presente dichiara sotto la propria esclusiva responsabilità che l'apparecchiatura è conforme a quanto prescritto dalla direttiva macchine 89/392/CEE.

Luogo e data di emissione Place and date of issue	Nome Name	Funzione Office Duty	Firma Signature
CERNUSCO S/N 28/05/15	MARISA GIAIOTTO	S.C.Q.	



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1 Datasheet

1st STAGE - SCRUBBER WITH H_2SO_4 - 2nd STAGE - SCRUBBER WITH NaOCL – 3rd STAGE – SCRUBBER WITH NaOH

CUSTOMER	AGRICARNITEC S.R.L.	
TYPE	HYDROCOL HY 20	
Inlet gas flowrate	m³/h	24.000
Inlet temperature max	°C	30
Inlet dust concentration	g/Nm³	AGRICARNITEC DATA
Material manufacture HY 20	PPH Polypropylene	
Speed into the Hydrocol HY 20	m/sec	1,75
Filling material		Ecoring PPH
Demister material	Ecoform PVC	
Height contact bundle	mm	1° 1000 – 2° 2500 – 3° 2000
Pressure drop HYD 22	mm c.a.	50
Dimensional drawing HYD 22	See the attached drawing	
Recirculating pump		
Total pump flowrate	m³/h	45
Prevalence	m	14
Installed power	kW	5,5
Rotational speed	Rpm	1450
Execution	Centrifugal horizontal axis	
Material	Polypropylene	
Fan	Type	Centrifugal
Flowrate	m³/h	24.000
Pressure @ 20 °C	mm w.c.	445
Installed power	kW	45
Dosing pump		
Total pump flowrate	l/h	20
Installed power	kW	0,18
Pressure	bar	5
Execution		Direct diaphragm
Material		Polypropylene



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2 Preamble

We recommend to frequently clean the machinery surfaces and the support floors, in order to avoid that bad ambient smells are generated by residues of condensates, greasing products and the like.

These bad smells can pass through the factory doors if air circulates between adjacent shed spaces; therefore it is important that the same doors are kept open for the strictest time required for vehicles and personnel to enter/exit.

Ambient air is renovated by clean outdoor air, to be blown in, and is extracted and then treated by the scrubber systems; louvers located on the shed walls enable said air extraction.

The air treatment plant must undergo periodical maintenance operations as indicated in a specific Section of this Manual.

Particular attention must be paid to the cleaning of the scrubber internals, frequently checking the scrubber bottom pools in the first months of operation. This will enable determining the correct time between consecutive cleanings and will avoid clogging phenomena of filtering meshes and filling bodies.

The best way is to monitor the washing media density, starting from the initial filling with clean water; as density raises, check scrubber bottom pools in order to determine how often the recirculating solution must be replaced and therefore too much build-ups of deposits are avoided.



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3 Preliminary controls at starting HYDROCOL 20

3.1 Gas flowrate

The selection of the "Hydrocol Scrubber" for the necessary gas flowrate (or range of flowrate) is based on the saturation conditions and considering the pressure drop through the scrubber as indicated on the "Design Data Sheet" you can see on page 4 of this manual.

This range identifies the best operating conditions for the unit.

An eventual decreasing of the gas flowrate means also a decreasing of the collecting efficiency.

If you think that the Hydrocol Scrubber has to operate with a flowrate higher than the one we indicated, please contact Air Ecosystem in order to know the maximum flowrate you can operate.

3.2 Starting - Preliminary controls

Remove all the water inlet spray nozzles and thoroughly flush out all water piping for at least 10 minutes at full line pressure.

This precaution is necessary to clean welding slag and remove trash from water supply piping system.

Provide a very careful inspection inside the unit, making sure of the following items:

- after cleaning of the water supply piping, reinstall the water inlet spray nozzles with the proper orientation as shown in the supplied drawing
- check that the internal sections of the scrubber are free from any kind of debris.
- Make the calibration of the internal floating levels (commonly called 'pear floating levels') by controlling the length of electrical cable and fixing it at appropriate measure with threaded cable gland, applied / to be applied to the specific polypropylene sleeve 1/2" outside the column .
- Check the correct functioning of the operating levels with the action of the manually contact in the pear at the specific position that allows the action of electricity:
 - Arrest of recirculation pump (mechanical security)
 - On / off solenoid filling water in the bottom column tank
- Open all spherical valves installed upstream and downstream of visual transparent levels (outside the scrubber)
- Open the circuit automatic filling of the tank using the specific solenoid valve commanded and controlled by a float level, previously calibrated and tested manually with the simple manual movement of the internal contact into the pear.
- Check any loss of fluid during the filling of the tank (open all the installed spherical valves - including upstream and downstream of the recirculation pump of washing



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solution) and intervene whenever is reached a fitting or a valve where there is loss of water.

- After the total filling of the tank, control the electrical link and start the recirculation pump of the washing solution: control the pressure indicated on the manometer installed on board the pipe pressing (outlet) in PVC vertical and control the absorption of current with a manual instrument.
- If necessary adjust the flowrate of the solution by acting on the manual spherical valve installed on the pressing pump (see technical data on its data sheet). When you reach the desired pressure, the valve should not be touched.
- Start the suction centrifugal fan, making sure that the upstream damper is closed and that it opens after achieving the project rotation speed. If there is an inverter it is not necessary to control this but you have to enter the parameters necessary for the start, the march and stop of the fan. Check the absorption of electricity at nominal conditions of the project and if necessary calibrate the flow of air sucked (acting on valves on the suction circuit) up to the value founded on the electric motor or to the value suitable for a good operation suction.
- Check the regular suction made by each aspirant taken (point) on the suction line in department and calibrate the specify valve manually.
- After starting the suction system and the air cleaning system check the dosage of chemical reagent as follows:
 - check all hydraulic connections of the electro pumps with the tank and the washing column, including the presence of pipe which works as a protective sleeve in case of breakage of the pipe and loss of chemical reagent.
 - check the electrical connections of electro pumps and the direction of rotation indicated by the arrow on the electric motor.
 - calibrate the safety valve (if present) installed on the press line following the procedures specified on the specific manual
 - calibrate the flowrate acting on the graduated knob installed at the side of the pump's body
 - verify the operation by sucking water from the suction pipe of the pump and verify the real arrival in the column separating the pipe at the point of junction on the tank
 - fill the tank only after verification of the dosage circuit and test operating with only water.
 - Check the connection of the measuring electrode pH / Redox (located in the cell outflow), the calibration with the appropriate solutions and enter the SET values for the operation of the necessary components to dose the chemical reagent required by the process.



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After all checks and tests of good operation of each device / component, start the suction system and treatment in AUTO mode by CYCLE START button on the front of electrical command and control panel .

Check the real start of all machinery and the regular operation of all accessories supplied (including electrical equipment) for the first few minutes after the start in AUTO system.

If necessary lubricate the rotating parts.

After about 30 ' / 60' check the temperature of bearings and monitor this parameter for about a week of continuous operation by referring to the highest values reported on specific manuals attached to this manual(fan - pumps).

3.3 Foundations

For foundations design refer to column and/or support brackets loads that you can see on the certified dimensional drawings.

3.4 Steel support structure

When the steel support structure is included in Air Ecosystem scope of supply and if it has small dimensions, it is usually delivered already installed.

In case it was shipped loose in bundles, for the erection you can refer to the related installation drawing supplied.

Before proceeding with the erection, all the parts have to be identified.

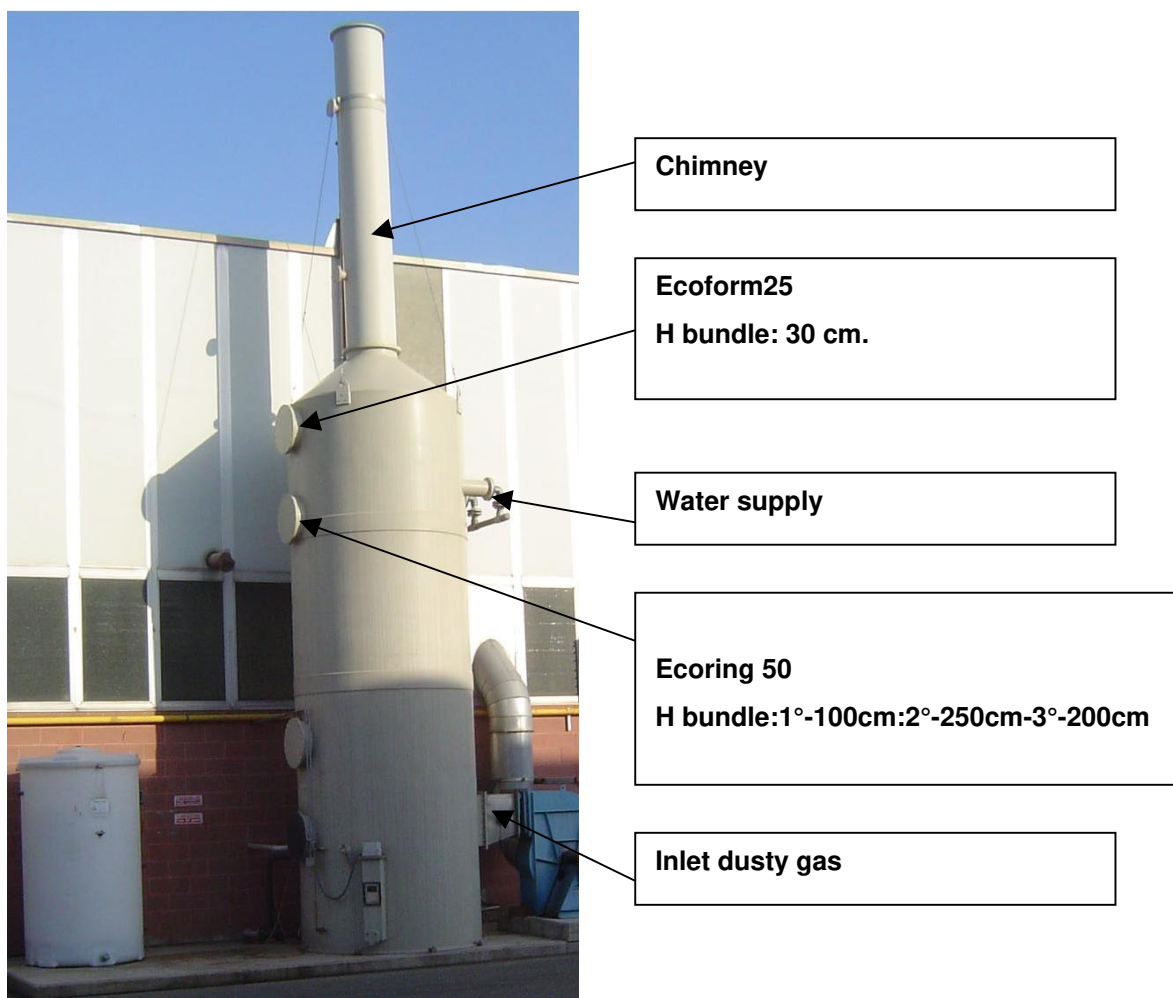
3.5 Scrubber assembly

All the units are pre-assembled at our workshop and match-marked.

The units above Size 21 are shipped loose for erection on site.

Assembly all the various sections following the scrubber drawings.

Gaskets have to be installed inside bolt circles and not snaked between bolts.



3.6 Inlet duct

The inlet duct is provided has to enter into the scrubber inclined from the top to the bottom of the scrubber. In this case the flowrate enter into the scrubber from its bottom flange and no duct is provided.

3.7 Chimney

The stack is usually manufactured with high thickness steel plates.

Therefore, if the scrubber section where stack is fixed to the scrubber is not stiffened, stack height can not exceed 4 meters.

When the stack exceed the 4 meters height, the stack has not to load on the scrubber i.e. it has to be provided a support structure dedicated to the stack.



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3.8 *Water supply pipeline*

Water supply pipeline and inlets are indicated on the related drawings.

When designing the water supply piping, provisions should be made to insure that it is possible to drain all the piping.

A gate valve has to be installed in each water supply line in order to allow the shut-off and the regulation of the scrubber water.

It is important that the required water rate be maintained to the scrubber and this can be assured by maintaining the specified readings on the pressure gauges: if you know that there are fluctuations in line pressure, a pressure regulator should be installed in the water supply line.

3.9 *Sludge discharge piping*

The sludge discharge piping should provide free drainage of the slurry to the discharge and decantation point which is a centralized treatment system or a recirculating tank by gravity.

If it is necessary to pump the slurry away from the scrubber, it is imperative that a surge tank be placed between the scrubber discharge outlet and the pump suction point.

The suction point should be located approximately 310 mm. below the normal liquid level ("U" traps are not to be used).

3.10 *Recirculating tanks*

In some applications it is necessary to install recirculating tanks.

The purpose of these tanks, both integral or separate, is to provide a reservoir for recirculating water.

Recirculating tanks are usually supplied with a simple float level control and a make-up water solenoid valve (if provided in the scope of supply).

The recirculating tank can be drain either continuously or in batches when the required concentration is reached.

Besides a part of recirculating water is continuously lost due to evaporation.

The float level control maintains a constant water level by actuating the solenoid valve on the make-up water supply line when required.

For some applications a float type level control as described above is not recommended/supplied and a different level control system will be provided.

The make-up water flowrate has to be the same of the water discharged during sludge drainage plus the quantity loss for evaporation.



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The maximum allowable suspended solids content vary with the application of the unit but **it has not to exceed 5%**

In some cases recirculating water may become acid: once this condition is established in the scrubbing water, it should be closely watched and properly control maintained.



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4 Controls and maintenance

Re-tighten all flange bolts after 48 hours of continuous operation and again after two weeks of continuous operation.

Frequent inspection is recommended, especially in the first operating week.

An inspection and cleaning schedule should be based on actual operating experience and necessity.

The inlet ducts and the inside of the collector must be kept free of accumulation which may impair operation.

An early estimation should be made of corrosive and abrasive wear so that replacement can be provided for worn parts or corrective measures be taken on time to prevent damages.

Specifically and carefully check water supply piping and spray nozzles for plugging or signs of wear (frequent problems if recirculated water with abrasive powders in suspension is used). Plugging of piping/nozzles can result in an inadequate water supply even at specified gauge pressures.

If the purge valve is installed, it is enough to program the TIMER inside the electrical panel and periodically verify the proper functioning of it. In case of continuous tapping of the solution, calibrate the expulsion spherical valve during testing; in case of partial weekly evacuation of the tank use the fund valve installed into the system overflow lowering of about 10 / 15 cm above the level of solution inside.

Annually:

- stop the system and provide a thorough cleaning of the interior columns, of the fan (wash impeller and control balancing with machine and specialized technical personnel) and all the components (drops separator, nozzles, transparent external levels, pear afloat levels and if necessary the plastic filling bodies (clean this part with water solution with sulphuric acid + recirculation pump running - fill the bottom tank after cleaning and removal of sludge and add acid to obtain a value of 2PH - at the end of cleaning empty the tank and fill it with clean water)
- check the plastic piping and valves; replace worn components that could cause a stop of the system at the next start after maintenance / cleaning

In case of unusual noises coming from rotating machines, stop the system and control the type of anomaly and act according to specific manuals and / or contacting the technical staff specialized of Air Ecosystem

Is also necessary to buy replacement components to solve the mechanical and electrical failures that will occur by normal wear components due to the hours of operation of the system.



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4.1 *Inspection doors hinges and bolts, pins, lifting lugs, etc.*

Coat lightly with grease for easy opening of doors and maximum protection of threads from oxidation

4.2 *Recommended Spare Parts List*

- RECIRCULATING PUMP (MOTOR EXCLUDED)
- CHEMICAL REAGENT PUMP (MOTOR INCLUDED)
- ELECTRIC MOTOR FOR FAN
- SET OF BELT
- BEARINGS
- ELECTRODE Ph/Redox
- FLOAT LEVEL CONTROL
- WATER SPRAY NOZZLES
- SOLENOID VALVE

Annex XIX: Maintenance WWTP

WWTP at Wasteserv TTF Maintenance Description		Yearly	Biannually	Quarterly	Monthly	Bimonthly	Weekly
R-Grid Section	Inspect, Test and service Sump Pump P01	✓					
	Inspect, Test and service Sump Pump P02	✓					
	Inspect, Test and service R-Grid Screen Motor M01	✓					
	Check all Pipe work		✓				
	Check all Valves for operation and repair/Replace as necessary			✓			
	Inspect, Test and service Level Sensor				✓		
	Grease and Lubricate all moving Parts				✓		
	Clean Sump, sump Pumps and level sensor					✓	
	Check Solid Material Bin and empty as necessary						✓
	Check Solid Material shoot and clean as necessary						
	Clean Grid						
U-DAF Section	Inspect, Test and service Submersible Lift Pump P03	✓					
	Inspect, Test and service Circulation Pump P04	✓					
	Inspect, Test and service stirrer Geared Motor M03	✓					
	Inspect, Test and service sludge scrapers motor + gear	✓					
	Inspect, Test and service Blower Motor 01		✓				
	Check proper operation of Flow meter F1		✓				
	Check proper operation of Dosing Pump PD.01 (PAC)		✓				
	Check proper operation of Dosing Pump PD.02 (NaOH)		✓				
	Check proper operation of Dosing Pump PD.03 (Polymer)		✓				
	Check proper operation of Dosing Pump PD.04 (Cloro)		✓				
	Inspect, Test and service Scraper Motor M02		✓				
	Check proper operation of electro Valve EV.01		✓				
	Check pressure sensor Pt.01		✓				
	Check all Pipe work		✓				
	Check all Valves for operation and repair/Replace as necessary			✓			
	Inspect, Test and service Level Sensor				✓		
	Maintenance and lubrication of scrapper chain and blades				✓		
	Inspection and Calibration of PH sensor PHs.01					✓	
	Check for accumulated sludge and clean as necessary						
BR Section	Inspect, Test and service Fill pump P05	✓					
	Inspect, Test and service Circulation pump P06	✓					
	Inspect, Test and service Discharge pump P07	✓					
	Inspect, Test and service Blower Motor 02		✓				
	Testing and Inspection of Bottom Sludge Lift system		✓				
	Testing and Inspection of Surface Scrubber system		✓				
	Testing and inspection of Air Box 2 including all Elettro Valves		✓				
	Inspect, Test and service all system valves and Pipe work		✓				
	Check pressure sensor Pt.02		✓				
	Check Pressure Switch Ps.01		✓				

5	Check operation of Oxygen monitoring system - O2t.01							✓				
	Check tank level system Lt.01							✓				
	Check Claro Filter Operation										✓	
	Check all Diaphragm Valves (x7)										✓	
	Check UV system										✓	
	Check lamps of UV system (x3)											✓
SLUDE Section	Inspect, Test and service of stirrer Geared Motor M04							✓				
	Inspect, Test and service all system valves and Pipe work							✓				
	Inspect, Test and service Discharge pump P08									✓		
	Inspect, Test and service Level Sensor									✓		

Daily	Bi-Daily	NEXT SCHUDULED Maintenance	Last Maintenance
		15 October 2020	15 November 2019
		15 October 2020	15 November 2019
		15 October 2020	15 November 2019
		15 June 2020	15 November 2019
		15 June 2020	03 March 2020
		15 May 2020	16 April 2020
		15 May 2020	16 April 2020
			Routine
			Routine
✓			Routine
	✓		Routine

		20 October 2020	15 November 2019
		20 October 2020	15 November 2019
		20 October 2020	15 November 2019
		20 October 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		28 May 2020	15 November 2019
		15 June 2020	03 March 2020
		15 May 2020	16 April 2020
		15 May 2020	16 April 2020
			Routine
✓			Routine

[illegible]

		03 June 2020	15 November 2019
		03 June 2020	15 November 2019
			Routine
			Routine
			Routine
			Routine
		03 June 2020	01 November 2019
		03 June 2020	01 November 2019
		15 May 2020	01 November 2019
		15 May 2020	01 November 2019

Annex XX: Storage & Residence Time of Main Waste Streams

Annex XX

The following table produced identifies the main waste streams stored at the facility. Other EWC codes permitted to enter the facility constitute a negligible fraction of material processed.

In terms of weight the codes tabulated below represent 99% of all waste accepted at the facility over the last five years.

Table 1: List of main items stored at the TTF for incineration/autoclaving

EWC code	Description	Storage Method	Maximum capacity	Residence time
02 01 02	Animal-tissue waste ANH	Stored in 1000litres IBCs and refrigerated in main fridge or reefers. One IBC may contain up to 800Kgs EWC Code 2 or 300Kgs EWC Code 18	674 IBCs	3-6 weeks*
02 02 02	Animal-tissue waste			
02 02 03	Materials unsuitable for consumption or processing			
02 05 01	Materials unsuitable for consumption or processing - Dairy product industry			
18 01 03*	Waste whose collection and disposal is subject to special requirements in order to prevent infection (used Sharps only)			
07 05 13*	Solid wastes containing hazardous substances	Stored inside hazardous stores	25 pallets	2-4 weeks*
07 05 14	Solid wastes other than those mentioned in 07 05 13			
15 01 10*	Packaging containing residues of or contaminated by dangerous substances			
15 02 02*	Absorbents, filter material (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances			
16 03 05*	Organic Wastes containing Hazardous Substances			
16 03 06	Organic wastes other than those mentioned in 16 03 05			
18 01 06*	Chemicals consisting of or containing hazardous substances			
18 01 09	Medicines other than those mentioned in 18 01 08			
13 02 08*	Other engine, gear and lubricating oils	Stored inside fire vaults	16 IBCs or pallets	8-10 weeks*

13 07 01*	Fuel oil and diesel			
19 12 01	paper and cardboard	Stored inside 1000 lt bins outdoor	80 bins	4-8 weeks*

*In the instance of maintenance, the resident time indicates the maximum period allowed following the return to normal operations.

Annex XXI: Future Improvements

Future Improvements at the Marsa Thermal Treatment Facility

1. Introduction

Wasteserv is endeavoring to improve its odour abatement infrastructure at the TTF. To this end, plans are in motion to invest in new Chemical Scrubbers and Regenerative Thermal Oxidizer (RTO), apart from an update to the infrastructure on site.

2. Areas of Interest

Before delving into the specifications and setup of the proposed Chemical Scrubbers and RTO, it is worth pointing out the following areas of interest:

Area A

- **Incinerator Shredder Room**
The shredder room is situated on the upper level of the facility and is adjacent to the plant room. ABP waste is shredded inside this room prior to being transferred for storage or incineration.
- **Main Refrigerator**
Shredded ABPs and clinical waste are stored inside this room at a lower temperature.
- **Waste Marshalling Area**
ABPs and clinical waste are temporary stored in this area prior to processing.

Refer to Figure 1 overleaf for an aerial view of Area A.

Area B

1. **Waste Receiving Area**
Area 1 in Figure 2 identifies the Waste Receiving Area of the Autoclave. ABPs received (at the Autoclave) are prepped in the Waste Receiving Area.
2. **CAT 1 Line**
Area 2 in Figure 2 identifies the CAT 1 Line. In this line, ABPs denoted Category 1 are processed.
3. **CAT 2/3 Line**
Area 3 in Figure 2 identifies the CAT 2/3 Line. In this line, ABPs denoted Category 2 and/or Category 3 are processed.
4. **New Scrubbers Location**
Area 4 in Figure 2 shows the proposed Chemical Scrubbers location.
5. **RTO Location**
Area 5 in Figure 2 shows the proposed RTO location.



Figure 1: Area A



Figure 2: Area B

3. Details of the New Setup

In order to mitigate odour as much as possible and reduce levels to a minimum, Wasteserv has devised the following plan:

Area A

A shed shall be erected to enclose the Marshalling Area depicted in Figure 1. Via this structure, bins temporary storage and/or queuing takes place inside, thus limiting odour and nuisance. It is projected that this development is completed prior to the installation of the equipment highlighted below.

The Shredder Room shall be equipped with fast roller shutters thus limiting fugitive air from this area.

Air from the Shredder Room, Main Refrigerator and Marshalling Area shall be directed and treated using a Chemical Scrubber. Specifications of the Chemical Scrubber are given below:

Scrubber #1

System:	Washing and chemical oxidation of air/ gases to reduce odours.
Air flow for treatment:	40,000 m ³ /h minimum.
Air changes per hour:	6 minimum (for the Waste Marshalling Area).
Equipment and Features:	<p>Fan.</p> <p>Vertical tower for chemical absorption.</p> <p>Washing solution recirculation.</p> <p>Level indicator and electro valve for water inlet.</p> <p>Control of automated purge via pH, conductivity meter and Rx meter / sensors system.</p> <p>Dosing pumps for chemical reagents.</p> <p>Chimney for exhaust dispersion.</p> <p>Demister prior to discharge of exhaust to atmosphere to prevent emission of drops to atmosphere and loss of washing solution.</p> <p>Purge with conductivity meter.</p>
Scrubbing Chemicals:	NaClO + NaOH (pH = 10 ± .5).
Reagents Tanks:	<p>NaClO tank – minimum capacity 5,000l ; maximum diameter 2000mm.</p> <p>NaOH tank – minimum capacity 1,000l ; maximum diameter 1500mm.</p> <p>Sized for a minimum of 7 days operation without refilling.</p> <p>Level indicator/s.</p> <p>Overflow, drainage and aeration.</p>
Control:	SCADA system.
Monitoring System:	Real time for VOC, H ₂ S, CH ₄ and NH ₃ .
Footprint & Location:	7m x 3m maximum Area 4 in Figure 2.
Standard:	All above equipment shall be designed and manufactured according to the respective standards, including CE mark.

Area B

The plant air from the Autoclave shall be treated via Scrubber #2. The specifications of Scrubber #2 are given overleaf. With the knowledge that heavy odours are generated during the unloading of cooked

products from the autoclave chamber and during the pressing process, Wasteserv decided on the treatment of the resulting air using a RTO. The design specifications of the RTO are indicated below.

Scrubber #2

System:	Washing and chemical oxidation of air/ gases to reduce odours.
Air flow for treatment:	70,000 m ³ /h minimum.
Air changes per hour:	8 minimum.
Equipment and Features:	<p>Fan.</p> <p>Vertical tower for chemical absorption.</p> <p>Washing solution recirculation.</p> <p>Level indicator and electro valve for water inlet.</p> <p>Control of automated purge via pH, conductivity meter and Rx meter / sensors system.</p> <p>Dosing pumps for chemical reagents.</p> <p>Chimney for exhaust dispersion.</p> <p>Demister prior to discharge of exhaust to atmosphere to prevent emission of drops to atmosphere and loss of washing solution.</p> <p>Purge with conductivity meter.</p>
Scrubbing Chemicals:	NaClO + NaOH (pH = 10 ± .5).
Reagents Tanks:	<p>NaClO tank – minimum capacity 8,000l ; maximum diameter 2000mm.</p> <p>NaOH tank – minimum capacity 1,000l ; maximum diameter 1500mm.</p> <p>Sized for a minimum of 7 days operation without refilling.</p> <p>Level indicator/s.</p> <p>Overflow, drainage and aeration.</p>
Control:	SCADA system.
Monitoring System:	Real time for VOC, H ₂ S, CH ₄ and NH ₃ .
Footprint & Location:	9m x 5m maximum Area 4 in Figure 2.
Standard:	All above equipment shall be designed and manufactured according to the respective standards, including CE mark.

Regenerative Thermal Oxidizer (RTO)

- RTO shall treat a minimum of 22,800 m³/hr, with an estimated total mass flowrate of 25,000 kg/hr.
- RTO shall be designed with up to 93% or better Heat Recovery.
- Destruction efficiency for odorous components of >99%.
- RTO shall oxidize air at a temperature of 850°C or higher.
- RTO heat transferring media shall be made from high efficiency ceramic capable of withstanding the operating temperature with low maintenance.
- RTO shall consist of 3 chambers (towers) for optimal energy efficiency.
RTO shall include an oxidation chamber connecting all three chambers.
Oxidation chambers shall be designed and manufactured to ensure a corresponding retention time with a 99% odour removal efficiency guarantee.
Chambers shall be lined with ceramic material to ensure effective thermal efficiency.
- Pneumatically operated leak-proof valves to manage flow of gases through the system.
- RTO burner shall be of automatic modulating type based on process parameters and include all required safety designs and measures.

Burner shall be designed and selected to not require human input for normal operations.

- RTO burner shall be designed in accordance with respective standards such as (not limited to) EN676.
- RTO shall come complete with all gas ancillaries required, such as the following:
 - Shut off valve;
 - Gas filter;
 - Pressure regulator valve;
 - Pressure gauge;
 - Necessary emergency equipment such as (not limited to) - Fusible link for burner gas shutoff.
 All gas ancillaries / equipment shall carry the CE mark, compliant with relevant standards and be ATEX rated for Zone 1 Class I Division 1.
- RTO shall be equipped, managed and/or controlled via SCADA system.
- RTO shall be equipped with a chimney.
- RTO shall be equipped / linked to a real time monitoring system for the monitoring of VOC, SO₂, CO and NO_x and dust
- RTO approximate footprint: 17m (L) x 7m (W)

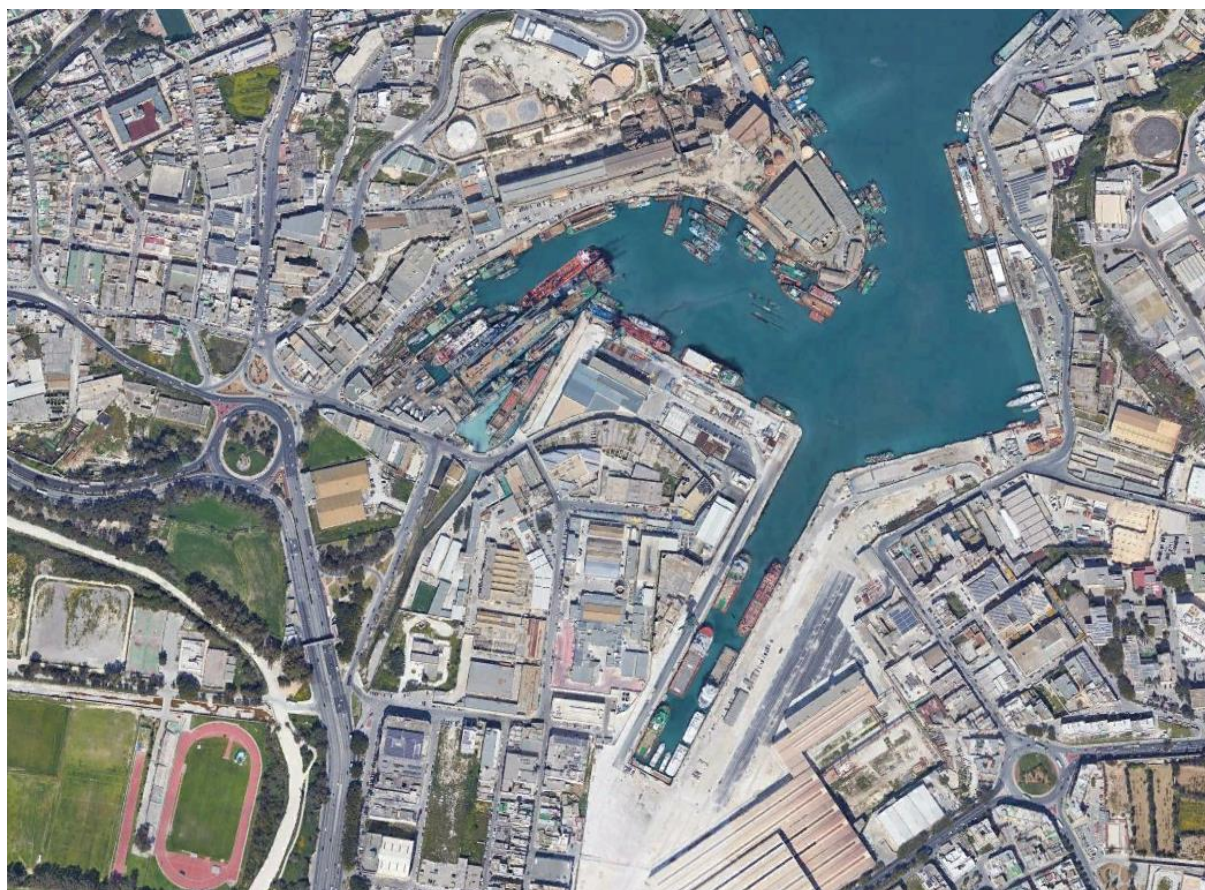
4. Timeline for Implementation

Milestone	Date of Occurrence
Start of Negotiated Procedure	week starting 11.01.2021
Contract Signing	week starting 05.04.2021
Delivery, Installation and Commissioning	12 months from Contract Signing

Annex XXII: Methodology of Bottom Ash Characterisation

Marsa Thermal Treatment Facility: Method Statement for testing of bottom ash

IPPC permit IP 0004/07/B



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Cover image from Google Earth (2017)

Introduction

1. The Marsa Thermal Treatment Facility (MTTF) consists of a waste management facility originally designed for the treatment of abattoir wastes, that was eventually adapted to treat a specific range of clinical and other hazardous wastes. The facility currently includes the following specified activities (or directly associated activities as defined under the IPPC regulations) as specified under IP 04/07/B:
 - **Incinerator** or waste incineration plant from the receipt, temporary storage and incineration of specified wastes, together with the flue-gas treatment, and temporary storage on site of residues generated;
 - **Waste heat recovery boiler and economiser**, for energy recovery;
 - **Diesel tank farm**, to store fuel for on-site use;
 - **Blood coagulator** for the sterilisation of blood, and separation of blood coagulum from water;
 - **Wastewater treatment plant**, for treatment of waste waters on site;
 - **Autoclave** intended for treatment of animal by-products received on site, and eventual disposal in the incinerator; and
 - **Diesel Generator** to generate electric power in case of electricity failure.
2. The above processes result in the production of bottom ash, which may be classified according to the following European waste Catalogue (EWC) mirror codes:
 - 19 01 11* bottom ash and slag containing hazardous substances
 - 19 01 12 bottom ash and slag other than those mentioned in 19 01 11

Distinguishing between the two codes requires reference to *Commission notice on technical guidance on the classification of waste* (2018/C 124/01).

3. The scope of this document is to propose a method statement for the analysis and characterization of a sample of bottom ash from the Marsa Thermal Treatment Facility. This shall involve sampling and analysis to determine the nature of the waste material, and hazard evaluation through hazard assessment involving identification and assessment of the worst-case compounds in line with the criteria laid down in Regulation (EC) No 1272/2008 (the CLP regulation), to determine the nature of the waste i.e. selection of the correct mirror code.

Bottom ash sampling and analysis

4. This sampling plan follows BS 14899:2005¹, where:
 - i. Involved parties have been identified and consulted;
 - ii. The objective of the sampling has been identified as determining the waste characterisation of the MTTF bottom ash to determine appropriate disposal options;
 - iii. The level of testing required has been determined as documented below;
 - iv. The constituents to be tested have been identified on the basis of available data, and in particular the expected nature of potentially polluting materials;
 - v. The relevant background on the waste generated has been researched and evaluated;
 - vi. Sample point selection has employed a judgemental approach giving appropriate consideration to the sample population, representative number of samples, and sampling pattern and locations, and sample size; and
 - vii. The most appropriate sampling techniques to be utilised have been selected, and sampling personnel are competent in terms of sample collection and required health and safety measures.
5. Given that production of bottom ash is a batch process collected in a bunker, sample collection shall be carried out on a weekly basis, and samples collected for storage. Sub-samples from a minimum of four weeks are collected and homogenised using appropriate techniques to produce a composite sample for analysis. All samples are retained until results are available, in case further investigations are deemed necessary due to the nature of the results.
6. *Best Available Techniques (BAT) conclusions for waste incineration*, under Directive 2010/75/EU of the European Parliament and of the Council provide direction regarding the required evaluation of bottom ash.

¹ EN 14899:2005 Characterisation of waste – Sampling of waste materials – Framework for the preparation and application of a Sampling Plan.

7. The following BAT conclusions are relevant:

- **BAT 7** where: '*BAT is to monitor the content of unburnt substances in slags and bottom ashes at the incineration plant with at least the frequency given below and in accordance with EN standards.*'

Parameter	Standard(s)	Minimum monitoring frequency	Monitoring associated with
Loss on ignition ⁽¹⁾	EN 14899 and either EN 15169 or EN 15935	Once every three months	BAT 14Error! Reference source not found.
Total organic carbon ⁽¹⁾ ⁽²⁾	EN 14899 and either EN 13137 or EN 15936		
<p>⁽¹⁾ Either the loss on ignition or the total organic carbon is monitored.</p> <p>⁽²⁾ Elemental carbon (e.g. determined according to DIN 19539) may be subtracted from the measurement result.</p>			

- **BAT 8** where: '*For the incineration of hazardous waste containing POPs, BAT is to determine the POP content in the output streams (e.g. slags and bottom ashes, flue-gas, waste water) after the commissioning of the incineration plant and after each change that may significantly affect the POP content in the output streams.*'

Description

The POP content in the output streams is determined by direct measurements or by indirect methods (e.g. the cumulated quantity of POPs in the fly ashes, dry FGC residues, waste water from FGC and related waste water treatment sludge may be determined by monitoring the POP contents in the flue-gas before and after the FGC system) or based on studies representative of the plant.

Applicability

Only applicable for plants that:

- incinerate hazardous waste with POP levels prior to incineration exceeding the concentration limits defined in Annex IV to Regulation (EC) No 850/2004 and amendments; and
- Do not meet the process description specifications of Chapter IV.G.2 point (g) of the UNEP technical guidelines UNEP/CHW.13/6/Add.1/Rev.1.

8. **Risks of hazardous materials in the bottom ash output:** the BAT conclusions highlighted above imply the need for evaluation of LOI and TOC. Given that the incinerator does not target the incineration of wastes containing POPs, inclusion of further POPs in the analysis is not considered necessary. However, the presence of dioxins and furans should be investigated to confirm the efficiency of the incineration process in abating the risk of generation of such substances during the process.
9. **Compositional analysis:** Given the above, and the proposed disposal in a non-hazardous landfill, it is proposed that the following chemical parameters be analysed following the list in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*. The chemical parameters requiring evaluation are:
- Arsenic
 - Barium
 - Cadmium
 - Chromium (valences III, VI and total)
 - Copper
 - Mercury
 - Molybdenum
 - Nickel
 - Lead
 - Antimony
 - Selenium
 - Zinc
 - Chloride
 - Fluoride
 - Sulphate
 - Total Dissolved Solids (TDS)
 - pH
 - ANC (acid neutralisation capacity)
 - Loss on Ignition (LOI) as percentage
 - TOC (total organic carbon) as percentage
 - BTEX (benzene, toluene, ethylbenzene and xylenes)
 - PCBs (polychlorinated biphenyls, 7 congeners)
 - Mineral oil (C10 to C40)
 - PAHs² (polycyclic aromatic hydrocarbons)
 - dioxins and furans

² PAHs suite (USEPA16):

Acenaphthene, Acenaphthylene, Anthracene, Benzo[a]anthracene, Benzo[a]pyrene, Benzo[e]pyrene, Benzo[b/j/k]fluoranthene, Benzo[g,h,i]perylene, Chrysene, Dibenzo[a,h]anthracene, Fluoranthene, Fluorene, Indeno[1,2,3-c,d]pyrene, Phenanthrene, Pyrene, Naphthalene

10. **Leachability analysis:** analysis of leachability as per EN 12457 is required to determine whether the material is suitable for disposal in a non-hazardous landfill. In this regard, leachability analysis shall include:

- arsenic
- barium
- cadmium
- chromium total
- copper
- mercury
- molybdenum
- nickel
- lead
- antimony
- selenium
- zinc
- chloride
- fluoride
- sulphate
- total dissolved solids
- Dissolved Organic Carbon (DOC)
- phenol index
- pH

11. **Methodologies:** confirmation of the methodologies to be used, nature of the testing and Limits of Detection shall be confirmed once laboratories (accredited to ISO 17025:2017) shall be contracted to carry out the required analysis. However, these parameters shall confirm to the requirements of *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*.

12. **Results and Evaluation:** a comprehensive interpretation report shall be provided together with the results, together with necessary records of the sampling details, a discussion on the results obtained, and a copy of the laboratory analytical reports and certificates. The nature of the wastes is to be evaluated in terms of composition, and also in terms of leachability. Compositional data will be used to determine the nature of the waste material, through identification and assessment of the worst-case compounds in line with the criteria laid down in Regulation (EC) No 1272/2008 (the CLP regulation). Such characterisation will then allow the proper distinction between the following codes:

- 19 01 11* bottom ash and slag containing hazardous substances
- 19 01 12 bottom ash and slag other than those mentioned in 19 01 11

The above will also be accompanied by Hazardous Property assessment, and appropriate codes assigned.

13. The evaluation of both compositional and leachability analysis will be used as required by Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills, to determine appropriate disposal options for the material.

Annex XXIII: BAT Comparison Waste Water Treatment

Conclusions on BAT from the Slaughterhouses and Animal By-products Industries BAT Reference Document (extract)

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
5.1.5 Treatment of waste water		
<p>BAT 34. For the treatment of waste water from slaughterhouses and animal by-products installations, BAT is to do the following:</p> <ol style="list-style-type: none"> 1. prevent waste water stagnation (see Section 4.1.43.3) 2. apply an initial screening of solids using sieves (see Section 4.1.43.4) at the slaughterhouse or animal by-products installation 3. remove fat from waste water, using a fat trap (see Section 4.1.43.9) 4. use a flotation plant, possibly combined with the use of flocculants, to remove additional solids (see Section 4.1.43.10) 5. use a waste water equalisation tank (see Section 4.1.43.11) 6. provide a waste water holding capacity in excess of routine requirements (see Section 4.1.43.1) 7. prevent liquid seepage and odour emissions from waste water treatment tanks, by sealing their sides and bases and either covering them or aerating them (see Sections 4.1.43.12 and 4.1.43.13) 	<ol style="list-style-type: none"> 1. Waste water is continually circulated around the WWTP. 2. Screens is in place to capture solids. 3. A grease trap is in place to capture fat. 4. Not in place. 5. Equalisation tank is in place. 6. Not in place. 7. Sides & base sealed. The fact the process is mainly aerated, minimises odour. 	<p>4, 6, 11 & 12 not in place.</p>

<p>8. subject the effluent to a biological treatment process. Aerobic and anaerobic treatments which are applied to waste water from slaughterhouses and animal by-products installations are described in Sections 2.3.1.2, 2.3.2.1.3, 4.1.43.14, 4.1.43.15, 4.2.6.2, 4.2.6.3 and 4.3.3.15</p> <p>9. remove nitrogen and phosphorus. Some information is given in Section 2.3.1.2</p> <p>10. remove the sludges produced and subject them to further animal by-product uses. These routes and their conditions of application are regulated by ABP Regulation 1774/2002/EC</p> <p>11. use CH₄ gas produced during anaerobic treatment for the production of heat and/or power</p> <p>12. subject the resulting effluent to tertiary treatment and</p> <p>13. regularly conduct laboratory analyses of the effluent composition and maintain records (see Section 4.1.43.2). Further information on monitoring techniques is available in the current "Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector" BREF [341, EC, 2002]. Note the emission levels given in Table 5.1 are generally considered to be appropriate for protecting the water environment and are indicative of the emission levels that would be achieved with those techniques generally considered to represent BAT. They do not necessarily represent levels currently achieved within the industry but are based on the expert judgment of the TWG.</p>	<p>8. Process mainly aerobic.</p> <p>9. Process includes denitrification and phosphorus removal.</p> <p>10. Sludges are removed and thereafter direct for incineration.</p> <p>11. Not in place.</p> <p>12. Not in place.</p> <p>13. Monitoring analyses are carried out and recorded.</p>	
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Parameter	COD	BOD ₅	SS	Nitrogen (total)	Phosphorus (total)	FOG		
Achievable emission level (mg/l)	25-125	10-40	5-60	15-40	2-5	2.6-15		
Table 5.1: Emission levels associated with BAT for minimising waste water emissions from slaughterhouses and animal by-products installations.								

Annex XXIV: WWTP Reservoirs Certification

Our Ref: 16094**Your Ref:**4th March 2019**Inspection Report*****Reservoirs at Waste Water Treatment Plant
Marsa Autoclave Facility, Xatt il-Mollijiet, Triq Garrick, Marsa***

To whom it may concern,

Reference is made to the waste water treatment plant and to the adjacent second class water reservoir situated at the location in caption.

Scope

The scope of this report is to verify the water-tightness of the above-mentioned reservoirs. The undersigned architect and civil engineer certifies that a visual inspection was carried out on the 4th March 2019 at the location in caption, which location is indicated in the aerial photo illustrated below.



Aerial Photo 1 – indicating the location of the reservoir within the Marsa Autoclave Facility

Observations

During the above-mentioned site inspection, it was noted that the second-class water reservoir and all the waste-water treatment plant reservoirs are in a good working order, and moreover no leaks were noted, thus effectively meaning that the structures are watertight and therefore serving their purpose.

Therefore, the undersigned certifies that the waste water treatment plant and the adjacent second class water treatment plant are watertight.

It is to be noted that, should the owner of the reservoirs perform any changes to the existing structure, or damage the existing structure, or perform any changes to the use of the reservoirs, further assessment should be performed to verify the water tightness of the said structures.

Yours Faithfully,

PERIT
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Perit Gilbert Bartolo B. E&A (Hons.), A.&C.E.

Annex XXV: Energy Flux Calculation

Energy flux from Mass and energy Balance measured in 2019

Boiler Power Power from Kiln Degasser power Condensate Power
2 2.88 0.19 0.23 MW

Energy flux = $\frac{\text{Boiler Outputs}}{\text{Boiler Inputs}}$ = $\frac{\text{Boiler Power}}{\text{Primary Kiln Power} + \text{Degasser power} + \text{Condensate power}}$

= $\frac{2}{2.88+0.19+0.23}$

= 0.606060606

Energy flux = 61%

Condensate Power			Degasser power consumption		
Enthalpy	255	kJ/kg	Enthalpy	2769	kJ/kg
Condensate Mass transfer	3200	kg/hr	Degasser Mass transfer	245	kg/hr
Temperature	61	*C	Temperature	171	*C
Pressure	1	Bar	Pressure	8.5	Bar
Energy= Enthalpy x Mass transfer			Energy= Enthalpy x Mass transfer		
Energy= 3200kg/hr x 255kJ/kg			Energy= 245kg/hr x 2769kJ/kg		
Energy= 816000 kJ/hr			Energy= 678405 kJ/hr		
Power= $\frac{\text{energy}}{\text{time}}$			Power= $\frac{\text{energy}}{\text{time}}$		
Power= $\frac{816000000}{3600}$ j/hr seconds			Power= $\frac{678405000}{3600}$ j/hr seconds		
Power= 226666.7 Watts			Power= 188445.8 Watts		
= 0.23 mW			= 0.19 mW		

Annex XXVI: 2nd Class Waste Water Readings

		Settleable Solids (≤20 mg/L)	Suspended Solid (≤500 mg/L)	Total Kjeldahl N (≤100 mg/L)	Sulphide (≤10 mg/L)	Hydrocyanic acid (≤10 mg/L)	Sulphate (≤1000 mg/L)	Grease (≤200 mg/L)	Chlorine (≤100 mg/L)	Chloride (≤1000 mg/L)	Total Chromium (≤5 mg/L)	Total Silver (≤5 mg/L)	Total Nickel (≤5 mg/L)	Total Copper (≤5 mg/L)	Total Lead (≤1 mg/L)	Total Zinc (≤10 mg/L)	Total Cobalt (mg/L)	Total non-ferrous metal (≤30 mg/L)	Total Arsenic (≤0.05 mg/L)	Fluoride (≤10 mg/L)	Boron (≤2 mg/L)	COD* (≤1000 mg/L)	BOD (≤500 mg/L)	Phosphorus (≤20 mg/L)	Dissolved Chromium (mg/L)	Dissolved Silver (mg/L)	Dissolved Nickel (mg/L)	Dissolved Copper (mg/L)	Dissolved Lead (mg/L)	Dissolved Zinc (mg/L)	Dissolved Cobalt (mg/L)	Total dissolved ferrous metals (≤10 mg/L)	
	pH (6-10)																																
Apr-20																																	
21.04.2020	8.01	0.00	30.00	191.48	0.20	0.00	130.00	<42	1.40	1100.00	0.03	<0.02	0.02	0.08	0.14	2.01		2.28	0.00	0.90	0.73	100.00	102.00	0.50									
27.04.2020	7.99	0.00	32.00	191.70	0.20	0.00	180.00	<42	1.60	1230.00	0.01	<0.02	0.03	0.00	0.02	0.28		0.34	0.00	0.00	0.61	230.00	134.00	0.60	0.01	<0.02	0.011	0	0.017	0.09	0	0.128	
29.04.2020	8.01	0.00	47.00	282.30	0.40	0.01	80.00	<42	3.30	1280.00	0.00	<0.02	0.01	0.01	0.14	0.19		0.35	0.00	0.00	0.77	470.00	75.00	0.50									
Average, day	8.00	0.00	36.33	221.83	0.27	0.00	130.00	#DIV/0!	2.10	1203.33	0.01	#DIV/0!	0.02	0.03	0.10	0.83		0.99	0.00	0.30	0.70	266.67	103.67	0.53	0.01	#DIV/0!	0.01	0.00	0.02	0.09	0.00	0.13	
May-20																																	
03.05.2020	8.03	0.00	94.00	137.25	0.14	0.00	120.00	311.00	1.90	1300.00	0.04	<0.02	0.02	0.02	0.27	0.16	0.00	0.51	0.00	0.40	0.83	500.00	193.00	0.40									
07.05.2020	7.51	0.00	90.00	211.90	0.23	0.01	390.00	<42	1.40	1350.00	0.02	<0.02	0.00	0.00	0.30	0.26	0.00	0.58	0.00	0.00	0.72	130.00	134.00	1.40									
11.05.2020	7.72	0.00	134.00	291.35	0.39	0.01	450.00	44.00	0.80	1130.00	0.04	<0.02	0.14	0.00	0.24	0.26	0.00	0.69	0.00	0.20	0.71	300.00	279.00	0.30	0.04	<0.02	0.03	0.00	0.24	0.18	0.00	0.49	
13.05.2020	7.87	0.00	167.00	334.90	0.47	0.02	400.00	428.00	4.90	1150.00	0.04	<0.02	0.01	0.00	0.16	0.24	0.00	0.46	0.00	0.01	0.62	480.00	306.00	0.60									
19.05.2020	8.06	0.00	111.00	362.51	2.30	0.02	260.00	47.00	2.10	1120.00	0.04	<0.02	0.02	0.00	0.18	0.14	0.04	0.42	0.00	0.00	1.14	810.00	316.00	1.00									
21.05.2020	7.83	0.00	103.00	483.45	7.70	0.01	120.00	220.00	1.30	1200.00	0.00	<0.02	0.00	0.00	0.27	0.36	0.04	0.67	0.00	2.20	1.40	1300.00	451.00	0.20									
25.05.2020	7.59	0.00	69.00	509.11	29.50	0.01	100.00	67.00	0.80	1290.00	0.04	<0.02	0.00	0.00	0.31	0.20	0.00	0.55	0.00	0.20	1.07	1160.00	386.00	0.00	0	<0.02	0	0	0.181	0	0	0.181	
29.05.2020	7.84	0.00	141.00	627.58	16.75	0.02	350.00	40.00	6.60	1200.00	0.02	<0.02	0.03	0.06	0.10	0.08	0.00	0.29	0.00	0.00	1.75	1420.00	649.00	0.20									
31.05.2020	8.03	0.00	160.00	639.41	17.50	0.02	30.00	80.00	0.60	1200.00	0.02	<0.02	0.03	0.00	0.27	0.18	0.06	0.55	0.00	0.00	2.41	1820.00	649.00	1.60									
Average, day	7.83	0.00	118.78	399.72	8.33	0.01	246.67	207.50	2.27	1215.56	0.03	#DIV/0!	0.03	0.01	0.23	0.21		0.52	0.00	0.33	1.18	880.00	373.67	0.63	0.04	#DIV/0!	0.03	0.00	0.24	0.18	0.00	0.34	
Jun-20																																	
04.06.20	8.28	0.00	190.00	544.75	15.00	0.03	20.00	<42	2.60	980.00	0.02	<0.02	0.02	0.00	0.25	0.06	0.00	0.352	0.00	0.00	2.22	1350.00	558.00	1.60									
08.06.20	8.15	0	186	652.18	18.5	0.013	40	79	1.7	1160	0	<0.02	0	0	0.224	0.06	0	0.284	0	0	0.854	620	42	1.8									
10.06.20	8.21	0	169	746.48	16	0.015	50	53	0.9	1050	0	<0.02	0.052	0	<0.100	0.2	0	0.252	0	0.6	0.854	540	413	2	0	<0.02	0.052	0	<0.100	0	0	0.052	
12.06.20	8.24	0	181	635.37	11.5	0.018	50	<42	1.3	1140	0.02	<0.02	0.098	0	0.102	0.16	0	0.38	0	0	1.864	992	386	1.8									
15.06.20	8.3	0	177	630.52	6	0.006	80	64	0.1	1320	0	<0.02	0.128	0	0.125	0.17	0.04	0.463	0	1.4	2.55	1100	370	1.4									
17.06.20	8.48	0	282	565.44	0.71	0.003	108	51	0.8	1320	0.02	<0.02	0.072	0	0.288	0.26	0	0.64	0	0	0.794	600	230	1.4	0	<0.02	0.072	0	0.288	0	0	0.36	
19.06.20	8.32	0	148	590.84	0.4	0	90	<42	0.11	1560	0.02	<0.02	0.099	0	0.163	0	0	0.282	0	1	0.708	530	295	1.8									
22.06.20	8.32	0	98	597.2	0.1	0.002	80	73	0.21	2000	0.02	<0.02	0.035	0	0.173	0.13	0	0.827	0	0	0.358	590	155	0.7									
24.06.20	8.32	0	63	307.5	0.18	0.007	90	<42	0.25	1410	0.01	<0.02	0.025	0	0.14	0.38	0.07	0.625	0	0.7	1.683	610	241	0.7	0.01	<0.02	<0.007	0	0.14	0.38	0.07	0.6	
26.06.20	8.27	0	63	234.2	0.14	0.007	40	83	0.08	1620	0	<0.02	0.044	0	0.127	0.1	0.23	0.501	0	0.6	1.059	370	230	0.8									
29.06.20	8.42	0	42	244.8	0.08	0.001	80	58.1	0.22	1670	0.01	<0.02	0.06	0	0.114	0.11	0	0.294	0	1.1	1.374	790	214	0.7									
Average, day	8.30	0.00	145.36	522.39	6.24	0.01	66.16	64.00	0.75	1384.55	0.01	#DIV/0!	0.06	0.00	0.17	0.15		0.40	0.00	0.49	1.31	735.64	284.91	1.34	0.00	#DIV/0!	0.06	0.00	0.29	0.00	0.00	0.21	
Jul-20																																	
01.07.20	8.11	0.00	73.00	217.28	0.20	0.00	110.00	<42	1.00	1800.00	0.03	<0.02	0.08	0.04	0.14	0.11	0.23	0.64	0.00	2.65	1.91	700.00	300.00	0.80	0.03	<0.02	0.024	0.03	0.143	0.1	0.02	0.347	
03.07.20	8.15	0	75	193.85	0.1	0.003	110	<42	3.1	1900	0	<0.02	0.089	0	0.152	0.18	0	0.42	0	1.1	0.997	430	247	1.4									
06.07.20	8.74	0	41	227.1	0.05	0.001	60	43	1.8	1850	0	<0.02	0.184	0	<0.100	0.03	0.02	0.23	0	0.38	1.167	600	204	0.6									
08.07.20	8.77	0	44	210.3	0.1	0.005	170	43	4.7	2100	0.03	<0.02	0.09	0	0.138	0.1	0.09	0.45	0.01	0.79	1.561	960	230	1	0.03	<0.02	0.07	0	<0.100	0.1	0.08	0.28	
10.07.20	8.87	0	38	210.7	0.08	0.007	240	<42	4.8	2360	0	<0.02	0.063	0	<0.100	0.07	0	0.13	0	0.95	0.75	190	107	0.8									
13.07.20	8.54	0	36	268.7	0	0.01	210	<42	3.6	2400	0.02	<0.02	0.032	0	<0.100	0.44	0	0.49	0.025	1.13	0.838	550	295	0.7									
15.07.20	8.43	0	71	222.5	0.15	0.002	260	<42	0.8	2280	0.01	<0.02	0.052	0	0.143	0.44	0.02	0.67	0	0.98	1.131	890	402	0.8	0.01	<0.02	0.023	0	0.127	0.25	0.02	0.43	
17.07.20	8.19	0	58	366.4	0.14	0.029	190	158	1.69	2125	0.02	<0.02	0.079	0	0.157	0.15	0.02	0.426	0	0.76	1.164	600	N/A	0.5									
20.07.20	8.08	0	32	256	0.07	0.016	200	<42	0.6	2075	0.02	<0.02	0.033	0	0.109	0.47	0.01	0.642	0.025	0.6	1.561	380	182	0.7									
22.07.20	8.2	0	64	295.9	0.075	0.01	270	345	0.39	1800	0.03	<0.02	0.029	0	0.153	0.21	0	0.422	0.025	0.84	1.184	230	236	0.9	0.03	<0.02	0.011	0	0.128	0.07	0	0.239	
27.07.20	8.2	0	56	322.9	0.1	0.014	240	107	1.4	2200	0.01	<0.02	0.052	0	0.136	0.07	0	0.268	0	0.85	1.81	490	220	1.4									
29.07.20	8.39	0	55	265.3	0.075	0.014	190	<42	1.7	2000	0.02	<0.02	0.029	0	0.138	0.13	0	0.317	0	1.34	0.748	470	279	0.4	0.01	<0.02	0.029	0	<0.1	0.1	0	0.139	
Average, day	8.39	0.00	53.58	254.74	0.10	0.01	187.50	81.33	2.13	2074.17	0.02	#DIV/0!	0.07	0.00	0.14	0.20		0.43	0.01	1.03	1.24	540.83	244.78	0.83	0.02	#DIV/0!	0.04	0.01	0.14	0.15	0.04	0.35	
Aug-20																																	
03.08.20	8.42	0.00	46.00	290.00	0.05	0.01	290.00	<42	0.40	1875.00	0.03	<0.02	0.02	0.07	<0.100	0.15	0.00	0.274	0.00	1.40	1.36	480.00</											