



## **TECHNICAL SPECIFICATION**

### ***FT 110 – 4D CREMATOR***

## **ANIMAL FT 110 – 4D CREMATOR**

### **1. Introduction**

The *Animal FT 110 4 D* Cremator has been specially designed to cater for the specific needs of the modern day Animal crematorium / disposal facility. The cremator will enable the proper disposal of animal and animal waste remains whilst complying with the necessary flue gas emission requirements and legislation of your country.

The design of this unit offers **four separate cells or hearths** to place individual animals for cremation as required by the operator.

The **operating capacity** of the cremator is **110 kg /h** of animal waste, typically domestic animals such as cats or dogs. This is based upon an average density of 700kg/m<sup>3</sup>, and an average calorific value of 16,000 kJ/kg.

This cremator has been designed after many years of experience and research in this specialised field. In designing the cremator, we have minimised the necessary labour required to operate it, and the simplicity of it's design ensures easy operation. The design of this cremator is very capable of reducing the animal waste to a high quality inert ash in a very efficient manner.

### **2. Environmental Performance**

The design of this *FT 110 4D* cremator gives rise to a **post combustion zone temperature** greater than **850°C**, for a time of greater than **2 seconds** during operation, with an **Oxygen** content of greater than **6%**, at it's maximum rated capacity **of 110kg/h of animal waste**.

3. **The Advanced Technical Features of the FT 110 4D Cremator include:-**

**ADVANCED CONTROLS :-**

- **Excellent Environmental Performance** – emissions conforming to current European and other World Standards.
- Two secondary combustion zone burners to ensure a secondary zone temperature of **850°C**, and **2 second residence time** which can be maintained under **all conditions of normal operation**.
- Flue Gas **Oxygen** Monitoring Equipment, of industrial, proprietary grade - supplied as Standard.
- **Automatic Oxygen control** - for improved combustion and reduced fuel operating costs – all supplied as Standard.
- **Advanced modern PLC control** features facility to ensure **optimum combustion** conditions by continuously monitoring throughout the process.
- Industry leading Personal Computer based **Human Man Interface** based upon Flat **Touch Screen** Technology.
- **Automatic control of suction** – to stop **overpressure** and smoke emissions from the cremator.
- **Separate Ejector Fan** Supplied as a Standard for **Guaranteed Safety** utilising design proven **Coanda ejector** technology for maximum cremator draught generation, using inverter speed controls.
- **Automatic control of air** - for maintaining optimum combustion conditions during operation.
- **Automatic temperature control** of both primary and post combustion zones.
- **Automatic fail safe** against over **temperature** and **pressure**.

### **ROBUST MECHANICAL DESIGN :-**

- **Robust construction** – a design capable of **up to 16 hours** per day operation.
- **4 no. Separate Robust Hearths**, designed for ease of use and easy raking, each fitted with separately controlled gas burner.
- **Hot Hearth design** - so minimising fuel costs.
- **Individual Motorised Doors**, fitted to each cremator hearth.
- **Fully sealed cremator fabrication** – so preventing leakage of tallow and animal fats out of the cremator.
- **Highest quality Refractories** - including **63%** Alumina in areas of heavy wear.
- **Excellent Extended Hearth Life**
- **Castable Refractories** selected for **Excellent Strength** and **Durability**
- **Excellent design** ensures **fats** are **contained** within the cremator and disposed of by the combustion process, within the specially designed secondary combustion chamber.
- **Compact** design, enabling easy installation and **easy maintenance**.
- Easily removable factory finished outer casing, reduces external temperature of cremator for improved operator **safety**.

#### 4. **PROPOSED INSTALLATION**

The basic **FT 110 4D** cremator will consist:

- Standard *Animal 4 hearth* Cremator installation
- Dedicated Combustion Air Fan in enclosure
- Dedicated Flue Gas Ejector Air Fan and Ejector System in enclosure.
- Automatic PLC based Control System complete with  
Easy to use Human Machine Interface (**HMI**) based,  
complete with Data Logging Package.  
and Fuji Electric Oxygen analyser.  
Remote Engineering Support – via Broadband connection.
- Stainless Steel Chimney.

## 5. CREMATOR General Description

### 5.1 Principle of Operation

The cremator comprises a primary chamber of generous proportions, separated into “four individual cremation chambers”, onto which the animals and/or animal waste are separately loaded. The main hearth is of a “hot hearth” design, heat recovered from the secondary combustion zone (below) heats up the flat hearth and so greatly reduces the fuel used by the 4 no. primary burners and hence minimises the operating costs of the cremator, and improve the combustion process. The primary chamber hearth comprises of shaped high alumina refractory tiles, the 4 no. primary chambers are entirely separate from the secondary chamber. The hearths are designed, so that all materials including tallow and fat are retained within the cremator. The tallow and fats are destroyed within the combustion process, and will not flow out of the cremator as fats. The waste flue gas produced from this phase of the process exits the primary chamber via a transfer port in the primary chamber side wall, descending below the solid hearth into the secondary combustion zone in which the gas phase combustion takes place.

The gases enter this secondary zone and are then heated by the secondary zone burner and treated by the introduction of additional air. The flue gases make two passes within the secondary combustion zone, before passing to the final section of the secondary combustion zone situated directly above the main chamber. Within the secondary combustion zone, the flue gas temperature is maintained at the required combustion temperature of 850°C, such that the two requirements of temperature and oxygen are met to ensure compliance to the local environmental requirements.

### 5.2 Main Combustion Chamber – multiple cells

The primary chamber is equipped with a four no. burners located in the rear wall, and independently controlled sets of combustion air to supply combustion air to each of the four chambers using side.

4 no. individual chambers; with chambers each supplied with side air. In general and for the purposes of the secondary chamber residence time calculation, the capacity of each chamber is as follows, chamber #1 – 50kg/h, chamber #2 - 30kg/h, chamber #3 – 15kg/h. and chamber # 4 – 15kg/h giving a total capacity of 110kg/hr.

### 5.3 Secondary Combustion Zone

The *Animal* cremator benefits from a generously designed secondary combustion zone, **5.7 m<sup>3</sup>** in volume, which is the required size to **ensure compliance** with the **legal** demands for a gas residence time of **2 seconds**.

The *Animal* Cremator is designed with a secondary combustion zone comprising

a series of passes below, and above of the primary chamber. This secondary combustion zone is fitted with 2 no. burners. Only by fitting two secondary zone burners can we ensure that the environmental temperature requirements are maintained while adequate supplies of secondary air ensure the correct levels of oxygen within the flue gases exiting the cremator. The design of the secondary combustion chambers ensures a lengthy, complex passage through the cremator so ensuring the high levels of turbulence to promote complete combustion of the flue gases prior to the flue gas exit from the secondary chamber.

Only when the above is completed within these high intensity areas within the secondary combustion zone, are smells and smoke fully eliminated from the process.

#### **5.4 Combustion System**

The main chamber is fitted with 4# burners (ignition burners) rating at 300kW, 200kW, 100kW and 100kW. These burners enable normal operating temperature in the range of 800°C-1000°C to be achieved in the main chamber. The purpose of these burners is to maintain normal operating temperatures, so ensuring that the waste is cremated to a high quality inert ash.

The main chamber burners are mounted at the rear side of the cremator facilitating access for maintenance and repair.

***(The PLC controlled system will automatically ensure the maximum allowable operating temperature is 1100°C to 1150°C).***

The secondary combustion zone is fitted with 2# burners, both having a maximum rating of 350 kW which will enable temperatures of 850°C to be achieved in the secondary chamber as required by the local Environmental Regulations. The purpose of these burners is wholly to burn the smoke and smell associated with the flue gases coming forward from combustion of the animal waste in the main chamber.

The secondary zone burners are mounted to the side of the cremator, both in positions facilitating good access for maintenance and repair.

The burners fitted are available as either oil or gas burners, dependent wholly on local site/client requirements.

For additional energy efficiency the gas burners are configured for **fully modulating control**. The burners are ignited automatically and the burner system is protected against flame failure, thereby complying with the gas regulations.

## **5.5 Control Valves and Instrumentation**

The controlled addition of combustion air to the combustion process shall be effected by 4# modulating control ball valves, supplying individual air supplies to the **four** main chamber air supplies together with an additional modulating valve for the supply of air to the secondary combustion chamber.

The cremator's main chamber under pressure conditions shall be controlled via a dedicated, proprietary differential pressure controller, controlling the eductor draught generation system, and also protect against system overpressures.

The main chamber and secondary chamber temperature are measured via type 'K' thermocouples, temperatures all independently displayed on temperature instruments as well as to cremator's Man Machine Interface.

The cremator is also fitted with individual combustion air pressure switches, to prove supply to cremator as well as individual pressure switches to each burner.

Similarly a gas supply pressure switch ensures sufficient gas pressure at the cremator if the cremator is configured for gas fuel supply.

## **5.6 Combustion Air System**

The cremator installation is supplied with combustion air by a dedicated fan, with a design duty capable of providing the air pressure and flow requirements of the *FT 110 4 D Animal Cremator*. The fan is located within an integrated enclosure so reducing acoustic noise levels.

## **5.7 Induced Ejector Draught System - *Cremator Underpressure/Draught Generation***

The *FT 110 4D Animal cremator* under pressure is constantly measured and controlled by the addition of a cooling air volume into the hot flue gases via a purposely design Coanda Ejector system located within the hot flue gas duct. For reasons of security the cremator is supplied with a dedicated ejector fan to supply the cooling air so as to generate the suction within the cremator, this air supply is in addition to the separate combustion air supply fan which supplies only combustion air to the cremator. The volume of ejector air is constantly modulated by a variable speed frequency inverter controlling the ejector air fan motor, the speed of fan (and the level of draught) is automatically controlled by the cremator's PLC control system, controlled by sensing the unit's underpressure.

The pressure sensor/controller also continually monitors any overpressure condition within the cremators main chamber. On detection of overpressure the combustion air to cremator is automatically turned off such that the combustion rate within the cremator is rapidly reduced. On sustained overpressure, the cremator will go into abort mode until the cause of problem is identified (for example, this could be the failure of the ejector air supply).

For added security, during periods of waste loading and de-ashing of the cremator, the control system automatically increases the amount of draught applied to the cremator so preventing smoke emission and excursions into the room, so increasing operator safety and comfort.

The separate ejector fan is also located within an integrated enclosure.

## **5.8 Cremator Process Control – PLC Based**

The **FT 110 4D Animal** cremator is supplied with a dedicated **Programmable Logic Controller**, this controller supervises the operation of the cremator and the combustion process.

Facultatieve Technologies utilise the Mitsubishi PLC and associated *Melsec* computer software for process control of the system.

## **5.9 Touch Screen Control System including Data Logging**

The **FT 110 4D** cremator, is supplied with a simple to use operator interface, comprising a **TFT Colour** Monitor.

For this option the PLC design will include a serial data card, which, via RS 232 system will communicate with a computer system (PC), thus allowing the use of our Microsoft Windows 10 based Opsoft Graphics package to operate a thoroughly modern **Supervisory Control And Data Acquisition** system – known as **SCADA**. For the purposes of Remote Access, the control system will be supplied with Team Viewer v.8

The software control programme includes automatic data logging, the information is used and a report is generated automatically in a format agreed by the local Environmental Authorities, and will require no further manipulation by the operator.

The supplied Windows Computer is supplied with a quality colour inkjet printer so enabling the cremator operator to print down the Data Logging reports.

The PLC based control system is capable of the **total control** of the cremator and all its functions, in order to cremate the animal wastes, once the cremation chamber has been charged.

The control system is designed to monitor many signal inputs including oxygen, and temperature levels in the waste gases and is capable of using these signals to control the rate of combustion at its optimum level.

The PLC control system **automatically** varies the combustion programme according to actual combustion conditions and **controls** the cremator at its

**optimum** performance to **operate quickly** and without smoke whilst also controlling the emissions. Should the need arise, provision is also provided for manual override. Manual control of the cremator is logged by the control system.

### **5.10 Cremator Process Control – Safety Features**

The burner flame failure and burner safety systems are housed separately from the burner. They comprise flame failure safety relays connected to a flame rectification type probe, to monitor "start" flame and "main" flame, so as to automatically shut off gas and air supply valves in the event of flame failure of the main burner or afterburner, and to prevent burner ignition if the safety circuits are not energised.

Separate fuel and air pressure switches are set to shut off the burners if the air or fuel pressure falls below pre-determined levels. Electrical interlocks also prevent the charging door being operated for the introduction of Animal waste unless the temperature in the secondary combustion zone exceeds 850°C.

The *Animal* cremator is fitted with automatic suction control to maintain a pre-set suction condition within the main chamber for all normal combustion conditions.

### **5.11 Remote Engineering Support**

To enable remote engineering support, the standard PLC control system is supplied with an industrial type computer modem, which enables remote observation of cremator parameters, retrieval and analysis of cremator emission data. This enables the cremator to be interrogated by our expert technicians to resolve operating problems without the initial requirement to attend site to rectify the problem

Such a modem facility, already operating with some working cremator units enables offsite maintenance scheduling and management and remote monitoring of cremator performance, and is only a phone call away.

### **5.12 Flue Gas Monitoring**

The *Animal* cremator is supplied (as standard) with an Oxygen analyser, and is located to enable the analyser reading to be on display to the operating staff at the most convenient points within the facility.

The standard *FT 110 4D Cremator* configuration provides for the continuous monitoring of:-

- Oxygen
- Main Chamber Temperature
- Post Combustion Chamber Temperature
- Flue gas temperature (Chimney)

*Optional (at extra cost), additional equipment may be supplied, including Opacity monitors, carbon monoxide monitors, chart recorders to enable continuous recording of operating parameters.*

## 6. CREMATOR Construction Description

### 6.1 Casing and Framework

The casing and framework of the cremator is fabricated of steel plate and sectional steel construction, the whole braced for rigidity, so as to properly support the refractory and insulating materials with which the casing is lined.

**The steel (welded) fabricated casing (including access ports) is fully sealed to prevent leakage of tallow and oils from the cremator**

The overall external dimensions of the cremator are:

The cremator size is generally as detailed by our Drawing **T- 0027**

### 6.2 Refractory Lining

High quality castable alumina refractory material is utilised for this cremator. This hot face refractory is backed by a castable lightweight insulating refractory at the furnace casing, and is supported from special high temperature stainless steel anchors welded onto the cremator's outer steel fabrication. The design of the secondary combustion chamber is such that the whole top section is fully removable, so simplifying installation.

The refractory material (M28 HR) used as the hot-face material for the main and secondary chamber a castable refractory of 40% alumina minimum , and has a **maximum** working temperature of **1400°C**.

In the areas of high wear, eg. the main hearth and areas of high turbulence, a special silicon carbide (SIC 60) castable material consisting 60% SIC is used which has high resistance to abrasion and thermal shock, and also a **maximum** working temperature of **1500°C**.

The supporting walls and interconnecting passages within the secondary combustion zone is fabricated in a similar specification of alumina firebrick – 42 and 63% alumina with similar working temperatures of **1350°C**.

### 6.3 Charge Doors (4no)

The refractory lined charge doors are situated at the front of the cremator and are automatic in operation. Operation is by means of electrically powered actuation controlled by adjacent push buttons, interlocked to prevent charging unless the secondary combustion zone is above 850°C.

The dimensions of each charging aperture are:-

	Door #1	Door #2	Doors #3 &4
Width	1.20 m	0.6 m	0.42 m
Height	0.595 m	0.595 m	0.46 m

#### 6.4 Ash Removal

Access for raking is through the charging doors. During operation, the charging door may be electrically powered opened so giving the operator access to the calcined remains on the hearth.

As an **automatic safety feature** the (ignition) burner within the chamber are switched **off** whenever the charging/insertion doors are opened, so that an operator **cannot** ash out with burners firing.

The ash is manually raked (using an ash rake) and removed from the hearth.

#### 6.5 Access for Maintenance

The need for access for maintenance has been carefully considered in the cremator design, and facilities have been provided for the cleaning out of accumulations of ash in any of the chambers and flue passages, access ports being provided for this purpose, as well as positioning all burners and instruments, in ready accessible positions.

#### 6.6 External Finish

Externally, the *FT 110 4 door Animal* cremator's main casing is clad with pre-finished painted panels before leaving our Works. As well as giving the cremator a pleasing appearance, these decorative panels ensure operator safety, by preventing any hot surfaces from being touched. The external decorative cladding panels ensure a gap of air between the hot cremator casing, and the external surfaces, which can be touched. This greatly reduces the external surface temperatures experienced.

## TECHNICAL SPECIFICATION

### REFRACTORY MATERIALS – FT 110 4D ANIMAL CREMATOR

#### High Alumina Castable Refractories

- **60% Silicon carbide** content refractory tile is used for the main hearth and the floor of the adjacent offtake flue. This tile has a **maximum** service temperature of **1500°C**, a bulk density of 2.45 g/cm<sup>3</sup>, and thermal conductivity of 1.62 W/m deg.C. The thickness of this tile is 76mm.
- The cremator walls and floor generally are all cast in a dense, medium alumina, high strength, high abrasion resistant castable refractory. This castable has an **alumina** content of **40% (minimum)**, and a maximum service temperature of **1400°C**.
- **63% alumina** content refractory is used in areas of high wear e.g. areas of high turbulence. This material has a high resistance to abrasion and thermal shock, a **maximum** service temperature of **1600°C**.
- **42% alumina** content refractory is used in the support walls of the cremator. This material has a high resistance to abrasion and thermal shock, a **maximum** service temperature of **1400°C**, bulk density 2.25 g/cm<sup>3</sup>, and thermal conductivity of 1.9 W/m deg.C.

#### Refractory Insulation

- The hot face refractory (described above) is backed by a castable lightweight insulating refractory at the furnace casing, and is supported from special high temperature stainless steel anchors welded onto the cremator's outer steel fabrication. The design of the secondary combustion chamber is such that the whole top section is fully removable, so simplifying installation.

## TECHNICAL DATA

### **– Animal CREMATOR**

#### **Primary Chamber #1**

width 1.0m                      depth 1.13m                      height 0.82m

#### **Primary Chamber #2**

width 0.6m                      depth 0.83m                      height 0.82m

#### **Primary Chamber #3**

width 0.42m                      depth 0.83m                      height 0.66m

#### **Primary Chamber #4**

width 0.42m                      depth 0.83m                      height 0.66m

## Secondary Combustion Chamber

Secondary combustion chamber volume	<b>5.7 m<sup>3</sup></b>
Residence time in Post combustion chamber	<b>&gt; 2 seconds</b>

A series of passages are made within the refractory lining of the cremator, under the main chamber hearth, and a separate chamber mounted above the main cremator. The post combustion chamber is specifically designed to ensure a **flue gas residence time of 2 seconds** at a flue gas temperature of 850 °C and an oxygen content of 6%

## Burners

Main chamber burner Package Burner design	#1 300 kW 100kW	Max fire Min fire
Main chamber burner Package Burner design	#2 200 kW 100kW	Max fire Min fire
Main chamber burner Package Burner design	#3 100 kW 50kW	Max fire Min fire
Main chamber burner Package Burner design	#4 100 kW 50kW	Max fire Min fire
Secondary chamber burner Package Burner design	two units 350 kW 150 kW	Max fire Min fire

Burner fuel: **Natural gas or LPG** (Propane/Butane) **or Diesel Oil**

Burner control mode- Continuous modulation of burner output, burners are low NOX design.

Burner Controls Flame failure

Flame detector Ionisation probe for gas fuel  
UV Cell for oil burners

Burner Gas Valves (Gas option)

Ignition Burner	Slow Release On / Off 240V Solenoid Gas Safety valve fully modulating.
Afterburner	Fully modulating 240V Gas Safety Control valve.

### Utility / Fuel Consumption

Typical gas consumption of the cremator <i>(Based upon eight hours per day, 5 days per week operation).</i>	35 - 70 m <sup>3</sup> / h of Natural Gas
Typical Electrical consumption	tba kWh

### Cremator Loading Door

The 4no. loading doors fitted to each chamber opens to allow for maximum access when loading cremator. This door is refractory lined and insulated to minimise outer surface temperature.

### Cremator Process Data

#### Temperatures

Main chamber temperature	Min	750°C
	Max	1150°C
	Varies with progress of cremation	
Secondary chamber temperature	Design	850°C
	Max	1150°C

#### Pressure

Static Underpressure in the main chamber	1 to 7 mm water column
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#### Flue Gas Volume in Chimney

Flue gas temperature	850 °C
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## Cremator Control/Instruments

### Thermocouples

Main chamber	No 4	Type K Ni / Cr Element
Secondary chamber	No 1	Type K Ni / Cr Element
Chimney	No 1	Type K Ni / Cr Element

Each of the above temperature probe is connected to a Temperature Indicator mounted on the control panel for visual indication of all process temperatures.

### Main chamber pressure controller

Manufacturer	Micatrone
Type	MFP

### Cremator Air Valve Motors

Manufacturer	Krom Schroder
Type	IC 20

Complete with Manual override

Flue Gas Sampling for Combustion Control  
Sampling of flue gases is made in the exit duct of the cremator.

## Cremator Flue Gas Analysis Equipment

### Oxygen Analyser

Principle of operation	Zirconia based
Manufacturer	Fuji Electric
Analyzer Model	Type ZRM
Detector Model	Type ZFK 2

Complete with High Temperature stainless steel flow guide tube, suitable for high temperature operation.

## Cremator Control System

### Programmable Logic Controller (PLC)

Manufacturer	Mitsubishi
Base unit Type	FX 3 U – 128 MT
Additional Analogue Mod	FX 3 U – 4AD– ADP

Facultatieve Technologies utilise the Mitsubishi PLC and associated *Me/sec* computer software for process control of the cremator.

The PLC software programme processes the input information so that it can give output control signals for combustion air levels, burner operation, draught control, loading door enabling and various other functions. The software also monitors for combustion and component faults, taking appropriate action as required and transmitting the alarms to the operator display system as necessary.

## PC Based Computer Graphics System

### TOUCH SCREEN Graphics System

The control of the whole cremator (and Filter System) will be controlled via a 15" TFT Flat screen controller fitted locally to the cremator. This system via a dedicated SCADA system gives rise to industry leading control graphics, and offers the added benefit of datalogging and Remote Engineering Support via a computer modem link.

### Computer Hardware

Windows PC with Broad connection and TFT Flat Screen Monitor. The PC will be supplied and preloaded with the following:

### Computer Software

Microsoft Windows 10  
Opsoft for Windows  
Integrated Graphics Package  
& Mitsubishi Melsec Package

### Remote Engineering Support System (Modem)

In order to support the cremator from our Technical Center, the cremator is supplied with the provision of high speed ADSL broadband, with fixed IP



address so enabling the cremator to be interrogated by expert technicians to resolve operating problems without the initial requirement to attend site to rectify the problem.

*Facultative Technologies has a policy of continuous improvement, and therefore reserve the right to amend this technical specification without prior notice.*