Hot Gas Filtration

glosfume
A breath of fresh air

October 2013

Introduction

Increasingly stringent EU and world-wide environment legislation presents fresh challenges to the many different industries generating hot polluted gas as a waste product from their operations.

From incineration of nuclear waste to wood fired biomass heating to product recovery, the hot gases generated must be treated and cleaned before they can be discharged to atmosphere. **glosfume®** can remove particulate emissions to below 3 mg/m³, typically 1 and can remove acid gases.

glosfume® with over 25 years research and development in this sector **glosfume®** can be relied on to provide expert advice, design and service.

glosfume® is possibly one of the only companies dedicated entirely to the filtration of hot gases, manufacturing 90% of all its major components in-house, as well as designing and installing complete filtration systems to provide cost-effective solutions, outstanding performance and dependable service.

Commissioning BMF filter

HTMC12(400) under construction.

What is hot gas filtration?

Hot gas emissions are produced by a wide range of processes, containing impurities or products which may be dangerous, toxic and polluting. They must not be allowed to escape to atmosphere without being filtered. Industrial waste gases often reach temperatures over 400°C.

Particulate matter is often sub-micron and will pass through conventional filters. Furthermore, high temperatures will cause bag-type filters to fail in a short time. A different filtration principle is needed for this type of application, that of ceramic filtration.

At **glosfume®** we have been producing ceramic hot gas filtration units for over 25 years and have carried out more than 1000 installations all over the world, from Argentina to Russia and Iceland to Australia you will find a **glosfume®** filter.

With our wealth of experience we are ideally equipped to handle even the most challenging applications, these have included:

Ammunition incineration
Animal carcass incineration
Activated carbon manufacture
Biomass wood-fired boilers
Black liquor production
Bronze production
Cobalt
Coal drying
Coloured sand production
Copper furnaces
Cement production
Gold recovery
HCl production
Iron smelting
Lead furnaces
Lithium oxide production
Municipal waste incineration
Magnesium smelting
Nano-particle production
Nickel oxide production
Nuclear waste disposal
Nickel and dross recovery
Primary & secondary aluminium production
Product recovery systems
Silicate production
Thermal oxidizers
Tin smelting
Uranium oxide production
Waste conversion
Waste-to-energy plants

Delivering a HTMC4(400) 2007

Biomass wood fired boilers

Burning biomass creates high levels of PM_{10} & $PM_{2.5}$, which includes sub-micron sized particles, which are not visible to the naked eye. The emissions depend on the type of boiler, mode of operation, as well as the type, quality, size and moisture content of the wood.

Because of this, some authorities have imposed restrictions on the use of biomass wood fired boilers.

At **glosfume®** we have designed filtration media to resolve these problems, resulting in ceramic filter elements coated with a micro-porous surface finish which will trap sub-micron particles.

Between 2007 & 2012 we have installed over 250 biomass ceramic filtration units, on boilers ranging from 50kW to 7MW capacity. The filter system is controlled via a PLC which regulates the on-board inverter and hence the filter exhaust fan speed, the PLC also controls a number of other features such as cleaning, bypass and temperature interlocks.

Schools 2011

Hospitals 2012

How does a glosfume® hot gas filtration unit work?

Polluted waste gases enter the housing on the dirty side and are drawn through the special, hollow “ceramic” filter elements into the clean side. The filter element structure is so fine that particles cannot pass through it. Instead, they lay on the outer surface of the element, while the filtered, clean gases are discharged to atmosphere.

In time, on the surface of the filter elements collected particulates increase in thickness, this creates a higher differential pressure across the filter elements. The pressure is recovered by reverse pulse cleaning, at a pre-set time compressed air is automatically blown back through the filter elements to discharge the collected particles as a filter cake. The removed material falls to the bottom of the filtration housing and is removed either manually via a collecting tray or automatically using a screw conveyor.

Section of a BMF filter

Bag filters or glosfume® ceramic filter elements?

Bag filters

- Poor thermal durability
- Flammable
- Not resistant to acid and alkalis when below dew point.
- Blind when subjected to high levels of sub-micron particles
- Typical maximum operating temperature 200°C
- Require heat exchangers, spark arresters, cyclones, reaction towers
- Typical emission 5 to 10mg/m^3

glosfume® ceramic filter elements

- Filter media withstand temperatures to 1000°C
- Not flammable
- Totally resistant to acid and alkalis above or below the dew point
- Withstands sub-micron particles
- Typical maximum operating temperature 450°C (mild steel housing).
- No requirement for cyclones, spark arresters or reaction towers
- Emission levels < 3mg/m^3, typically 1

The efficiency of **glosfume®** filter elements was measured by French Nuclear Fuels in trials at various sites. The emission levels recorded were as low as 0.0017 mg/Nm^3.

HTMC modular designs

While **glosfume®** are always ready to design tailor-made systems, our standard range is made up of four standard size modules (referred to as pods) rated at 3000, 5000, 7300 and 9800 Am^3/hr respectively.

These modules referred to as the HTMC range can be linked together to form filtration units with practically no limits in size and performance.

Typical examples are shown in the following photographs:

HTMC1 (400) 1999

HTMC2 (400) 2008

A HTMC6 (400) 2004
6 modules in a straight line

A HTMC6 (400) 2001
3 side by side

Advantages of a modular filtration system

- The filtration system can be a single module or multiple, linked modules
- Complete filtration systems can be shipped in separate modules to facilitate transport
- Systems are easy to install.
- Individual modules can be shut down for maintenance, without process closure, ensuring maximum operational flexibility
- Small footprint and low height
- System can be easily extended at a later date, if required

glosfume® filter elements

At the heart of the **glosfume®** filtration unit are the "ceramic" filter elements. These were initially designed and developed to eliminate the high cost of bought in elements and more importantly to improve quality and strength with a consistent pressure drop.

It took three years to establish our own in-house manufacturing facilities for producing the filter elements, operated by our subsidiary company Glosfume Technologies Ltd. Glosfume Ltd hold a stock at all times of between 6,000 to 10,000 elements.

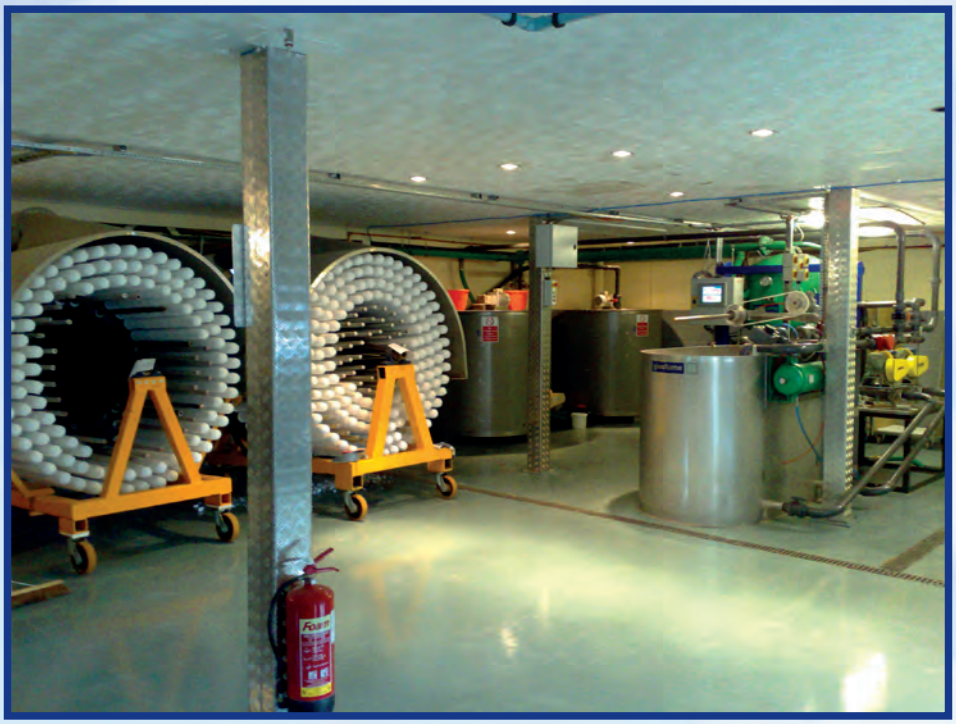
We make three standard types of element:

- G3 is a ceramic element which will operate at temperatures up to 1100°C.
- G4 is a mineral element which will operate at temperatures up to 750°C.
- S4 is a mineral based manufactured from Low Bio-Persistent Fibres element suitable for temperatures up to 1100°C.

All our filter elements are produced with an outside diameter of 60 mm (tapered to 55 mm) and are 1000 mm long. These dimensions have been shown to achieve optimum performance for particulate removal and dry scrubbing.

All our filter elements are manufactured in-house from known engineered fibres, using a fully computerised process. Forming times and pressures are tightly controlled to achieve stable bulk density and a specific pressure drop. Each day 10% of all elements are tested and recorded on a data-base and are then packed in bar-coded packaging to ensure full traceability.

Unlike conventional bag filters and other types of filters, **glosfume®** ceramic filters are highly efficient – up to 99.99%. They are able to remove sub-micron sized particles including nano-particles.



Glosfume Technologies vacuum forming plant 2010

glosfume® and dry scrubbing – a perfect partnership

Emissions may contain acid gases such as HCl, HF, SO_2 and dioxins. Pollutants can be neutralized by scrubbing, using sodium bicarbonate or lime and activated carbon.

The disadvantages of conventional bag filter systems

Where lime is normally used as the scrubbing medium it must be maintained in a temperature range of 100° to 130°C. At higher temperatures consumption increases and efficiency falls.

If sodium bicarbonate is used, the operating temperature must be maintained between 140° and 200°C. At 200°C there is a risk that the filter bags will catch fire.

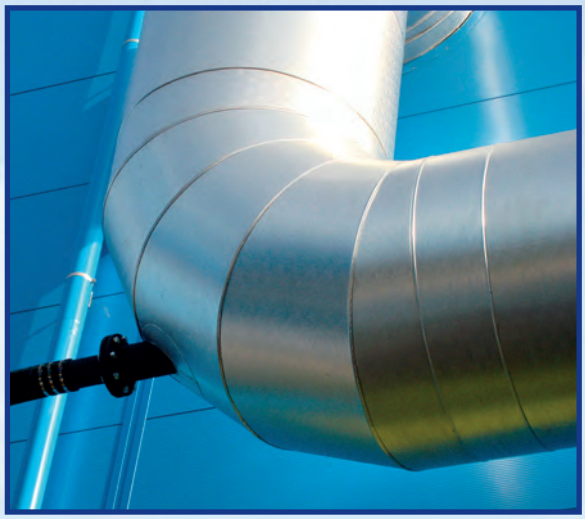
Finally, bag filters must operate at lower gas velocities and therefore require the addition of costly reaction towers and recycle lines to achieve efficient dry scrubbing.

The advantages of using sodium bicarbonate with glosfume® filters

Sodium bicarbonate remains fully active with no variation in consumption between 140°C and 450°C. To ensure optimum efficiency and the fullest use of the sodium bicarbonate, each complete **glosfume®** filter unit has been carefully modelled using computational fluid dynamics (CFD) to plot the pattern of particulate retention positions. CFD design also helps to ensure that pollutants are uniformly presented over the whole of each filter element and that the absorbent is drawn onto the elements where the reaction takes place.

All **glosfume®** filters are designed to function efficiently and reliably over the important range of between 140 and 450°C.

A one-tonne big bag feeder injects absorbent



Injection point of absorbent

Further benefits of glosfume® filters in dry scrubbing applications

Of course, there are no filter bags to catch fire.

Removing HCl at temperatures above 400°C prevents reformation of dioxins.

A certain amount of the sodium bicarbonate converts to a gas, which means that there is less material to go to land-fill. This makes sodium bicarbonate preferable to lime where environmentally friendly disposal is important.

Using **glosfume®** high-temperature ceramic filters and dry scrubbing with sodium bicarbonate and/or activated carbon achieves outstanding emission results.

The following typical figures show clearly how our high-temperature ceramic filter systems meet current and probable future regulations. All the results are around 90% lower than the official emission limits.

Waste Incineration Directive emission limits for carcass incineration

Pollutant	Directive limits	Results with glosfume® filters
PM	10.0 mg/m^3	0.7
VOCs	10.0 mg/m^3	0.8
HCl	10.0 mg/m^3	1.4
SO_2	50.0 mg/m^3	4.9
CO	50.0 mg/m^3	1.0
Dioxins	0.1 ng/m^3	0.013

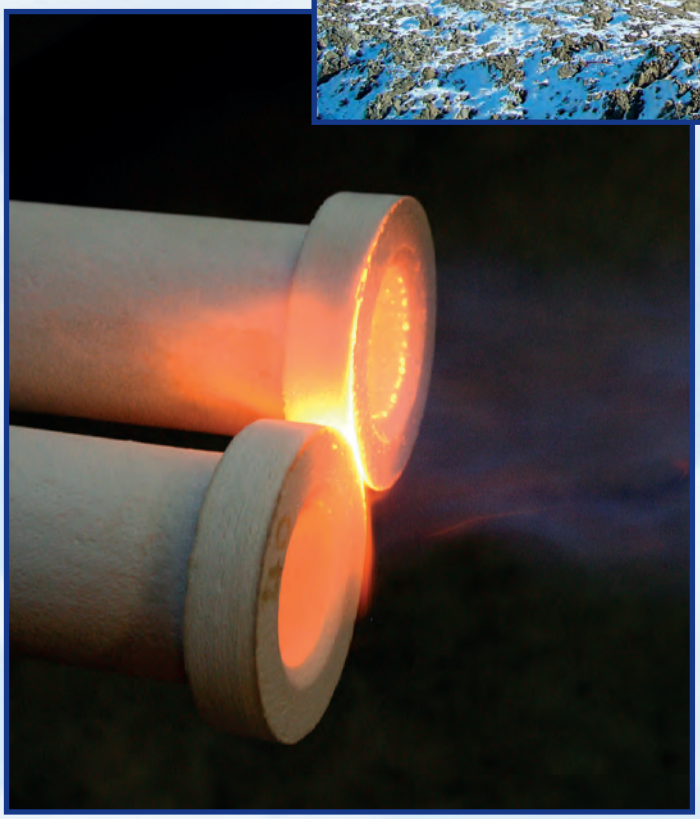
HTMC12(400) 1998

Hot gas filtration

Since the late 1980's **glosfume®** has designed and installed more than 1000 hot gas filtration systems in the UK, Europe and around the world.

Projects include filtration plants for animal carcass incineration, such as the installation in 2006 of the UK's first carcass incinerator to comply with the terms of the Waste Incineration Directive. This installation was subsequently selected by the British Government's Department for the Environment, Food & Rural Affairs (DEFRA) for the disposal of cattle infected by foot and mouth disease during 2006. The plant had capacity to incinerate 4000kg/hr, 24/7.

HTMC5(400) Carcass Incineration 1997



Soluble elements

In-house manufacture

We manufacture practically all the components of our hot gas filtration systems in-house.

The ceramic filter elements are made by our subsidiary company Glosfume Technologies Ltd. Glosfume Ltd fabricate all filter bodies, walkways, support structures, pressure vessels, ducting and other parts required.

In this way we have everything under our control. We are not dependent on outside suppliers and can change our production schedules flexibly to react promptly to special customer requirements.

We can manufacture in house standard steel housings up to a weight of 4 tonnes these are rated for operating temperatures up to 450°C. Special versions can be supplied for higher temperatures in various grades of steel.

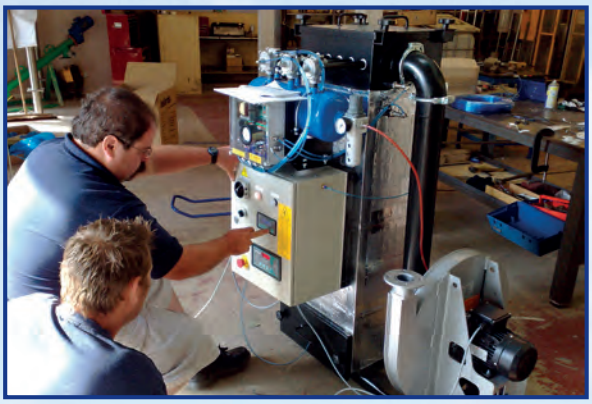
All parts of the filter housings are laser cut to maintain correct alignment between the ceramic filter elements and the automatic reverse jet cleaning system. Larger units are fabricated by **glosfume®** approved fabricators.

The modular design of **glosfume®** filtration units makes it possible for them to be shipped pre-assembled, including elements, or as separate units for final assembly at the customer's site. This makes for easier transport, shipment and installation.

Where our filtration units are to be exported and if requested by the customer, we will manufacture just the filter head and allow the customer to fabricate basic items such as hoppers, frames and ductwork locally. This enables significant material cost savings to be made and also reduces the shipping costs.

One of our three work shops

Filter head



Research and development

Lloyds certification for air tanks

Controls

The Glosfume Filtration System uses the latest PLC and touch screen technology to ensure accurate process control while providing all the addition benefits of a modern touch screen control system.

A screenshot from the Biomass BMF range

Benefits Include:-

- TFT 6" Touch screen.
- PID Loop controlled pressure regulation ensures suction remains constant regardless of temperature or load.
- Monitoring for all parameters which are data logged for traceability, tracking and trending.
- Multi-level setup and password protection of the parameters ensures only authorised users can modify settings.
- System comes in English, German and French as standard and other languages are available on request.
- Upgrades and custom modifications can be performed by swapping a 'Flash card' in the unit, no laptops, no programming cables, no hassle.
- All units can be connected to land based or cellular broadband connections for remote monitoring.

BMF2200

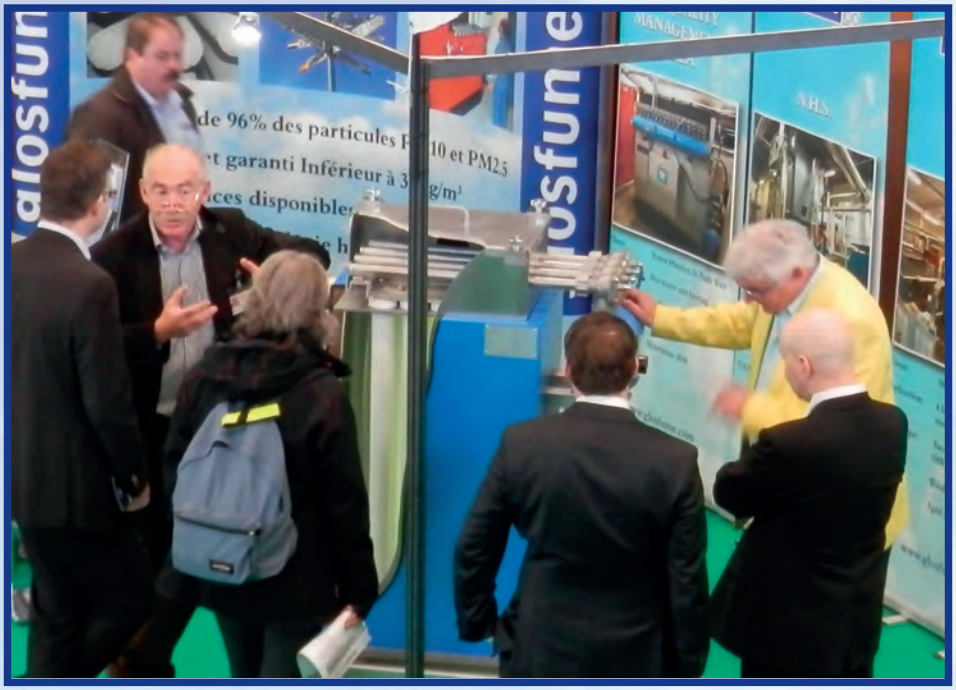
Our company and people

Over more than 25 years **glosfume®**, a privately-owned company, has built its reputation as the world leader in the design and manufacture of high-performance ceramic hot gas filtration systems. Our tailored products and modular designs are installed in countries all around the world.

The success of **glosfume®** has been earned by a team of specialist people with years of experience in the field of hot gas filtration. We know the problems facing our customers and work with them to decide on the optimum solution for their needs. In most cases a number of linked standard **glosfume®** modules will be the answer; otherwise we will design special units to resolve special needs.

The company was founded by Bob Roberts, whose expertise has generated its expansion to the flourishing organisation it is today. In 2012 he decided to concentrate on special activities and the position of managing director passed to Jon Luckett. Jon has been with the company since the 1996 and has a gained a wealth of experience in our business.

Our technical director, Nigel Black, spent 27 years with CRE working on combustion before joining **glosfume®**. His skills enable the company to offer the best in filtration for biomass wood-fired boilers. The great thing about Nigel is that it is black or white and no shades of grey.



France 2012

Our quality

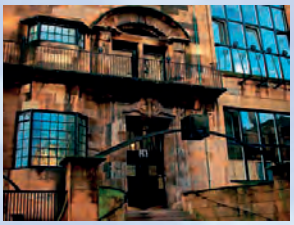
Because we make practically every part of the units ourselves, we have the confidence to offer an extended guarantee on everything we supply, which can be up to 24 months.

This guarantee does not apply unconditionally to the ceramic filter elements themselves, their life depends on the severity of the operating conditions. In normal conditions they may last for many years and replacements are always available from stock.

Typical installations

Over the years we have supplied **glosfume®** units to a wide range of different customers and applications. The following are some of the more interesting.

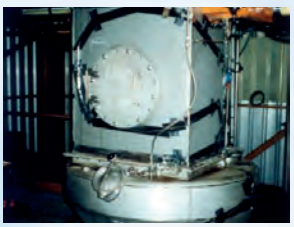
The world-famous chef Jamie Oliver installed a food waste-to-energy plant to provide hot water to the kitchens. Unfortunately it also produced a great deal of impurities which were discharged to atmosphere and covered the customers' cars in ash. We installed a biomass filtration unit which solved the problem.



Scotland has stringent regulations restricting the use of biomass wood fired boilers in urban areas. To obtain permission the Mackintosh Institute in Glasgow was obliged to install a **glosfume®** BMF filtration unit.

ALCAN operated an induction furnace smelting oily swarf. This generated particulates and oily fumes which are now captured by one of our filter units which recycles talc to absorb the oil.

A main stream contractor to British American Tobacco identified the advantage using glosfume® filtration. Picture showing the filter undergoing a factory acceptance test.



French Nuclear Fuel manufacture uranium oxide and were using a bag filter which required dilution air. This affected the quality of the oxide.

We installed a pilot filter which operated at 500°C and no dilution air was required, thus greatly improving the quality of the oxide.

At Fontevraud, France two BMF biomass wood-fired boilers filtration units are installed close to the grave of the medieval English king, Richard the Lionheart. The filters are on display to the general public and stand behind a plate glass window. A touch screen is available and lights up various areas of the boiler room explaining how the system works.

Some of our more well known customers

British Army

Korean Navy

Russian Navy

glosfume®
the ultimate solution for
hot gas filtration

Awards

Winners of the Energy Globe National Award 2012

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