



## TECHNICAL MEMORANDUM

**TO:** UK Consortium Members

**FROM:** Milan Kluko; President, Fountainhead Engineering, Ltd.  
Bruce W. Bawkon; P.E., Senior Engineer, Fountainhead Engineering, Ltd

**DATE:** September 22, 2000

**SUBJECT:** **The Whitton Technology Air Curtain Destructor Model S-127**

**COPY:** Brian O'Connor, Norbert Furhmann, Whitton Technology, Amy L. Miller  
CHMM; Principal Fountainhead Engineering, Ltd.

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Fountainhead Engineering, Ltd. (FOUNTAINHEAD) has developed this detailed overview of the technical specifications of the Whitton Technology S-Series Mechanical Combustion Unit (MCU) air curtain destructor. FOUNTAINHEAD in cooperation with the manufacturer of the MCU Whitton Technology (Whitton) has provided this information to be used for securing authorizations from the Environment Agency (EA) as well as for your general reference.

### **1. GENERAL ASPECTS OF ENVIRONMENTAL AGENCY GUIDANCE REGARDING THE MCU INCINERATION PROCESSES**

Very shortly the EA of England and Wales will publish their guidelines for new combustion systems and we are attempting to have the EA consider "reasonable" regulations (authorizations) regarding this new (to the UK and Ireland) this specific technology manufactured by Whitton Technology.

### **2. DESCRIPTION OF EQUIPMENT**

This mechanical combustion unit or MCU is a departure from typical combustion equipment upon which most air quality regulations have historically been developed. The S-Series MCU has a patented manifold design and it is engineered specifically to the dimensions of the combustion chamber. It has a specialized ceramic refractory lining that surrounds the combustion chamber. *Therefore it is quite different from other air curtain devices and incineration technologies.* This combustion system does not utilize a stack to transport

combustion gases out of the primary or secondary furnace or boiler, which in turn passes into particulate and/or other air pollution control devices such as electric static precipitators (ESP's), bag houses or acid gas scrubbing systems. The primary combustion chamber is also not totally enclosed on four sides like most furnaces or boilers. These primary differences present some unique situations with the typical "air quality" approval process. This will be discussed in greater detail in Section 6 of this Technical Memorandum. The engineering aspects of this unit rely on the fact that it is completely self-contained and the unit functions in a fashion that does not rely solely on an air delivery system blowing air across the unit for optimum emission control or combustion performance. The S-Series MCU relies on several integrated systems supporting functions that enhance the operation of the MCU. This approach has refined the "air curtain concept". We will refer periodically to the S-127 series MCU but the technology for the other S-Series MCU is identical.

### **3. DESCRIPTION OF PROCESS**

There are several variations of the S-Series MCU manufactured by Whitton Technology. The S-127 MCU is 37'4" long, 11'9" wide and 10'3" in height. The S-121 model is 32'2" long, 11'9" wide and 10'3" in height. The S-127 weighs approximately 65,000 lbs. and the S-121 weighs 41,000 lbs. Whitton also manufactures an S-116 model, which is 25' 5" long, 7' 10" wide, and 7' 6" in height and weighs 24,500 lbs. The majority of the discussions in this memorandum are directed towards the Whitton Technology "S-Series" machines and the S-127 specifications are used as the basis for most of the narrative describing the Whitton Technology ACD's as well as potential emission and throughout calculations. These above ground, self-contained, refractory lined combustion units are designed to reduce waste stream volume and are primarily targeted for combustible material and waste wood waste streams. This technology is a lower cost alternative to wood chipping and tub grinding.

The S-127 MCU is a mobile system that combusts waste wood, pallets, demolition debris, fiber products and landscape wastes in an environmentally safe fashion. The system accomplishes this with maximum volume reduction and minimum opacity. The MCU is a fully self-contained engineered system. The S-127 system is capable of processing up to 18 tons per hour of "bulk" wood waste such large tree trimmings, pallets and other waste wood material while the S-121 system is capable of processing up to 15 tons per hour of waste wood feedstock.

The principle of the air curtain concept is optimized through the Whitton Technology design. High velocity air is directed across and downwards at a specific angle into the combustion area creating the air curtain on top and a rotational turbulence within the combustion chamber or "firebox". The rotational turbulence provides an oxygen enriched environment within the combustion zone which accelerates the combustion process by raising the temperatures within the pit to 2,300°F to 2,800°F ( $\approx$ 1,375°C to 1,550°C).

The average theoretical daily processing or throughput rate, based on a typical eight-hour day using 5,000 Btu per pound feedstock like wood waste, would be high as high 145 tons or 90 cubic yards per hour (or approximately 800 cubic yards per day), depending on the feedstock. Opacity and particulate emissions are extremely low during normal operating

conditions. Complete combustion of the wood waste insures maximum volume reduction with maximum safety since this is being accomplished in a refractory-lined chamber that provides for very high operating temperatures while the rotational turbulence created by the patented air curtain manifold system provides an over oxygenated combustion environment.

The MCU is constructed on 10-inch square skids. The MCU can be moved or relocated at a site very simply by attaching hooks, cables etc., to either pad eyes or lift lugs and then lifting or dragging the entire unit along the ground by a front end loader, backhoe, crane or similar equipment. The Diesel engine is mounted on a channel rack. The entire front deck is covered with ¼" (6.35 mm) steel diamond plate. All welds are continuous fillet welds for overall strength. The entire structural unit receives two coats of primer and three coats of orange gloss enamel paint for optimum protection.

The forward equipment deck supports a four-cylinder diesel engine, 100-gallon fuel tank, the drive system and the fan. When viewing from the front of the unit, the patented 14" diameter air disbursement manifold is mounted on the top left side of the combustion chamber. The entire combustion box or chamber is comprised of refractory panels. The rear of the combustion chamber is constructed with refractory lined panel doors. The doors swing open in opposite directions for access to the interior of the unit for removal of residual ash. After cleaning, the doors are closed and the unit is ready to operate. Attachment A contains schematic drawings of the MCU.

The diesel engine, operating at 1,500 to 2,000 RPM (max. 2,400 RPM) drives the primary motor that in turn drives the fan mechanism in order to achieve approximately 2,000 RPM's that generate a minimum airflow of 15,000 cubic feet per minute (CFM). This high velocity air is directed down the manifold through restricted outlets. The fan is designed so as to direct high velocity air down a *patented* air disbursement manifold that redirects the air over and down into the combustion pit.

Measurements from the S models verify that the unit can operate at a minimum average nozzle discharge velocity over 9,050 feet per minute (FPM) with minimum nozzle discharge airflow of 760 CFM per 12" nozzle length. Several of the readings during testing exceeded 9,050 with the highest reading being 11,559.58 FPM (October 1998). This results in complete combustion of all wood feedstocks while providing excellent particulate control.

The air curtain delivery system for this MCU acts as a "lid" over the firebox, trapping particulate while simultaneously providing excess oxygen to the combustion area thereby promoting a more intense and uniform fire and insures complete combustion of the feedstock (combustible material). The fan, operating at approximately 2,000 RPM's and 6" w.g. (1,490 Pa) minimum static pressure, produces in excess of 18,000 cubic feet (510 m<sup>3</sup>) per minute of airflow. The manifold is equipped with patented "scuffers" that partition off the required amount of air through the entire length of the manifold so as to maintain a uniform discharge rate along the entire length of the firebox or combustion chamber. As mentioned previously, the vanes in the discharge nozzle produce discharge port exit velocities of 760 CFM per foot of nozzle length. The system's effectiveness in entraining particulate using a continuously operating air curtain is proven and unmatched when

compared to other similar mobile systems. Improvements have resulted in superior control fugitive emissions. Most authorizations in the United States require the operator to maintain opacity between 10 to 20 percent. In the United States obtaining authorization for operation of the MCU (in most states) has been reduced to a very simple process primary associated with wood waste and herbaceous waste streams.

In urban areas like the New York, Los Angeles or Chicago metropolitan area (population of approximately 5 million people) which is located in the northern interior portion of the United States on the south shore of Lake Michigan (states of Illinois and Indiana) the operating approval process requires a simple procedure since the air curtain technology is a well-proven technology. The City of Chicago with a population of 3 million people has the third largest forestry department in the United States. Chicago and the surrounding metropolitan areas (with populations of over 2,000,000) has more single family residences and has many parks and green areas that generate significant landscape or "herbaceous" material associated with tree maintenance and seasonal trimming of landscaping as these areas also generate significant wood waste associated with new construction and demolition of older structures. Scarce landfill disposal capacity has led to the banning of landscape waste in landfills in Illinois and other states. Difficulty in selling or distributing wood chips from grinding operations at yardwaste composting facilities have developed since the landfill ban has caused major disposal and health issues in surrounding communities. Chipping or grinding of these waste streams is expensive, loud and does not significantly reduce the volume of incoming landscape wastes. During a recent outbreak of the Asian Longhorn Beetle in Chicago hundreds of infected trees were removed in 1998 and 1999 and the infected trees were chipped and ultimately disposed of using an air curtain destructor. The chipping of the trees was accomplished only to aid with transportation to the air curtain destructor for final processing.

The state of California with a total population of over 15 million people has the most stringent air quality regulations in the United States, if not in the world. In May 2000 California issued its first authorization specifically for the Whitton Technology S series technology with very limited regulatory review due to the effectiveness of the MCU's integrated air curtain technology. The primary operational restrictions were associated with opacity (limited to 20% or No. 1 as designated on the Ringlemann Chart). The maximum loading shall be limited to 25 tons per hour and the operation of the S-127 shall not exceed twelve hours per day.

In Indiana any applicant wishing to use air curtain destructors for wood waste processing must demonstrate an average air flow velocity which is the major technical aspect of obtaining an authorization. Testing of the airflow from the Whitton Technology air curtain nozzles has proven compliance with Indiana standards. Once again operational restrictions are associated with daily operations. The air curtain destructor can only be operated 1 hour after official sunrise and no waste is to be fed after two hours before official sunset. The air curtain destructor shall not be located less than 250 feet from a private residence and no less than 500 feet from any pipeline or fuel storage area. The destructor must be operated and maintained according to manufacturer's specifications and not operated during periods of extremely high winds or when there is air stagnation or when a pollution alert or ozone action day has been declared. The limited use of air

curtain destructors is allowed for herbaceous and other untreated wood waste streams such as dimensional lumber scraps, furniture cuts and pallets. No other air curtain device has been evaluated "in the field" using United States Environmental Protection Agency (USEPA) methodologies to verify that this specific combustion technology has been engineered to function as a self-contained combustion-control system.

Regulators in the United States understand the nature of the air curtain effectiveness and have developed appropriate minimum performance standards and regulations to restrict its application. It is neither unregulated nor over regulated. The intent of using the MCU in many applications, especially in urban areas, is to provide another alternative to reduce the volume of waste that would otherwise be sent to landfills. In addition the MCU can economically process wood waste when compared to chipping or grinding and reduce the potential of "leftover" wood grid or wood chips (produced after chipping or grinding) that cannot be marketed or distributed in a timely fashion thus presenting a potential health hazard. The volume of grind or chips produced cannot always be used in yardwaste composting facilities and may rot causing this material and the yardwaste compost to become "unmarketable". The state of Florida has issued permits or authorizations for the S Series system since the late 1980's and these units have operated consistently with operating conditions for over a decade. The MCU is one component of a comprehensive solid waste management system and is very cost effective when compared to chipping or grinding. Many public and private sector customers have used the S Series for storm and hurricane cleanup or for processing of waste streams after unfortunate natural events.

The manifold system that produces and distributes the air curtain serves as a very effective particulate control mechanism while at the same time is providing the equivalent of "over fire" and "under fire" air supply continuously promoting complete combustion. The velocity and aspect of the air introduced into the Whitton Technology S Series combustion chamber greatly enhances the primary objective of most incineration devices, which is complete combustion at very high temperatures. Temperatures achieved by this unit while burning wood, vegetative and similar combustible materials typically range between 1,600°F to 2,300°F. The refractory walls contain the heat within the combustion chamber so that 24" away from the outside of the refractory walls the ambient temperature is only slightly higher than atmospheric temperature.

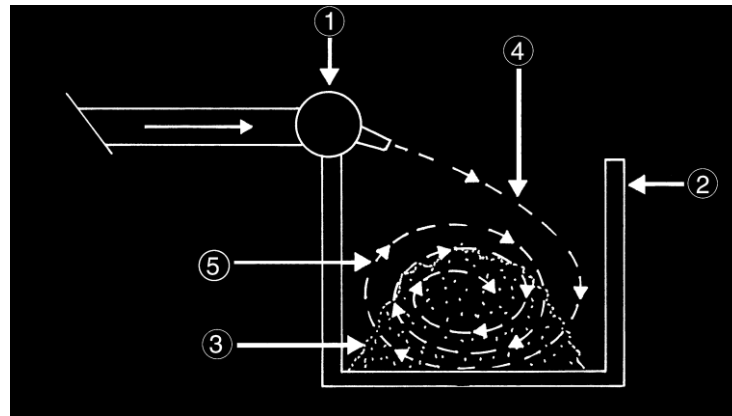
The refractory panels and door frames are poured with a castable refractory of 4" (102 mm) rated at 2,800° F (1,540°C). After curing, the castable thermal ceramic panels have a cold crushing strength of up to 5,000 PSI (352 kg/cm<sup>2</sup>). Each (side) panel weighs approximately 1,200 lbs. (544 kg) and is equipped with two steel pad eyes for easy removal and replacement. The two refractory panel doors weigh approximately 1,700 lbs. (771 kg) each. Four custom hinges support the doors.

The intense oxygen flow ("over oxygenated" combustion) derived from the patented manifold system coupled with the specific geometric design of the firebox essentially creates an after burner effect. By re-circulating the air under the curtain, residence time of the particulate is increased long enough to insure effective combustion (pyrolization) with virtually no smoke or ash escaping from the unit.

#### 4. THE PRINCIPLE OF AIR CURTAIN COMBUSTION

The primary operating principle of an *air curtain* is to control particulate emissions. Another advantage in this specific application is that it provides more oxygen for the fire that result in complete combustion. The introduction of a controlled high velocity air stream across the upper portion of the combustion chamber creates a powerful curtain of air excluding the major pathway for particulate and other fugitive emissions. When introduced during the combustion process, the super-heated air created in this process actually becomes a rotating mass of high temperature air averaging up to 2,300°F (or 1,260°C) that has been trapped in the combustion chamber.

The fuel input (waste material) and airflow can be modified rather simply. A reduction (or increase) in the air velocity from the air curtain manifold into the combustion chamber changes the aspect of the fire within the combustion chamber. Fuel modification is accomplished by changing the feed rate of the material so that good combustion is achieved and maintained without the need for supplemental fuel sources (i.e. natural gas). This also eliminates the need for over fire or under fire air in order to achieve maximum Btu production from the fire and insure complete combustion, which results in significant volume reduction. The following diagram illustrates the fundamental operating principal of the self-contained refractory lined mobile combustion unit – MCU.



1. MCU patented manifold illustrating nozzles that direct high velocity airflow into refractory lined combustion box.
2. Refractory lined walls used to both absorb and reflect heat back into the primary combustion area surround the combustion chamber or firebox.
3. Combustible material (feedstock) to be burned.
4. Airflow schematic forming high velocity “air curtain” that acts as a controlling device to trap fugitive particulate while also providing increased oxygen for combustion.
5. Illustration of representative airflow produced by air curtain refracting off of the chamber walls over-oxygenating the fire resulting in high temperatures in the firebox.

The sustained turbulence within the firebox or combustion chamber results in complete combustion while the protective (air) curtain created by the rotating air significantly reduces fugitive emissions. The “S-Series system” incorporates “built in” redundant levels of pollution control, not redundant pieces of combustion and air pollution control devices.

## **5. OPERATION OF THE WHITTON TECHNOLOGY AIR CURTAIN DESTRUCTOR**

The combustion chamber or firebox is loaded using a backhoe or front-end loader. A small skid steer loader with a grapple attachment can also be used for loading or “packing” the combustible material. Care should be given to the direction of prevailing winds and should be away from the loading side of the firebox. In order to understand how to load the firebox, you must first understand why it is important to do so in a specific manner. The normal starting procedure is to start a fire in the bottom of the firebox. A fire started in the bottom will climb to the surface igniting material on the way up. The procedure is relatively straightforward:

- A. Load sufficient small, dry and clean brush or wood into the bottom of the firebox to a level of about 2 to 3 feet, making sure the entire bottom area of the firebox is covered.
- B. Establish that there is sufficient small material (less than two inches in diameter) in the bottom, followed by larger diameter branches or untreated lumber. This should then be followed by larger material such as logs (six to ten inches in diameter) followed by larger diameter material and stumps. Sufficient time should be allocated in constructing this “second layer” and insuring that it is also well packed and that it is level across the firebox.
- C. All material placed in the firebox should be tightly packed. If there are large air spaces between the combustible materials it will not ignite efficiently and combustion will not accelerate and progress properly causing the initial fire in the combustion chamber to be difficult to maintain which could lead to excessive (opacity) smoking during startup phase.
- D. Feedstock in the firebox that will be ignited should be kept about two feet below the top of the firebox. Care should be taken to ensure material does not extend above the top of the firebox. The loading of material into firebox is always performed from the opposite side of the manifold.
- E. A petroleum-based product is often used to aid with ignition. Pour the accelerant near the bottom 1/3 of the pile of material within the MCU. This is usually accomplished using no more 5 gallons of diesel or kerosene fuel. An ignition device (torch device) is used to initially ignite the accelerant that is used to start combustion of the feedstock or wood waste. Charcoal, fiber ignition logs or a propane ignition device can also be used for lighting the fire. Once flames begin to appear above the manifold, engage the operating lever of the motor with the throttle at idle speed. As the fire begins to spread and temperatures increase the RPM’s of the MCU should also be increased

slowly in increments of no more than approximately 200 RPMs. If diesel is used (as the initial accelerant) the darker characteristics of the “startup plume” will dissipate quickly and after the (diesel) plume has dissipated and the MCU startup plume is visible (i.e. white smoke versus dark smoke) the engine speed is increased again by 200 RPMs. If using kerosene the plume will not appear as dark as a diesel plume. As RPMs are increased in increments of approximately 200 RPMs, visible opacity should reduce to 15% (from approximately 35-45% during the initial 15-20 minute startup phase).

As the temperature of the fire in the combustion chamber increases, the engine speed is also increased to approximately 1,800 RPM’s. Ultimately, the normal operating range of the S-127 MCU should be between 1,500-1,900 RPMs.

Adherence to the startup procedures described should achieve optimum operating temperatures in the combustion chamber and therefore opacity should not exceed a Ringelmann Smoke Number of 1.0 after 30 minutes of operation. Once again the opacity is used to verify good combustion and is a consistent verifiable measure of appropriate operating conditions. Record the startup conditions using the USEPA methodologies (Method 9) described during previous presentations. The USEPA Method 9 is provided as a separate document to this Technical Memorandum. Until a similar methodology is developed by the EA this should insure adequate documentation of compliance. There are potential modifications that could be made to the walls of the MCU to allow for insertion of a four foot propane extension so that a cleaner fuel could be used to ignite the material within the firebox. This would require a slight modification to the system.

It is imperative to observe what type of material should be added to the fire, when to add additional material, and where to place the material. This is a function of the dynamics of the fire and the procedure is refined through experience with the MCU. Material is slowly added for the first 60 minutes after engaging the air distribution system (i.e. air curtain). It takes approximately one hour for the fire to reach maximum temperature. If hot spots develop in the fire, dense material such as stumps or shorter denser pieces of waste wood should be placed in these areas.

The fire across the top of the MCU should be relatively level and at no time should new material be stacked higher than the MCU manifold. The firebox must be loaded continuously throughout the day in order maintain sufficient operating temperatures. If the fire is not loaded continuously, the heat will subside which will result in excessive smoke and increased opacity. All loading should stop about two hours before the fire is to be extinguished. As the fire burns down the airflow through the manifold must be maintained and possibly slightly increased in order to keep the remainder of the material burning hot.

The volume of material that can be processed per hour is a function of density of the waste material, moisture content of the waste material, loading techniques and the time period in which optimum temperatures in the pit can be retained. Upon completion of the combustion stage (i.e. when an active hot fire is being continuously maintained), the waste material will be reduced in bulk by 95% leaving only 5% in volume as residual ash. System efficiency will be reduced once the residual ash build-up reaches approximately 1.5 to 2

feet (76 cm maximum) in the bottom of the firebox. Typically after two days of operation the ash will need to be removed from the system depending on the type of materials being combusted with the MCU. If the operator is combusting organic material such as tree trimmings, stumps, logs or other herbaceous wood waste (including non-treated wood waste) the highest and best use of the ash residue is as soil amendment. Yard waste composting or other organic composting systems require a specific nitrogen-carbon ratio to be maintained for effective decomposition of organic feedstocks and this residual ash is a very good carbon source. If the operator of the MCU is combusting treated or painted wood waste or other mixed fiber waste streams (i.e. construction or demolition debris) there is a potential for the residual ash to have traces of organic and inorganic compounds (metals). In this case the ash should be tested using appropriate analytical testing methods for the requisite regulated constituents of concern (COC) that may prohibit beneficial reuse of the ash. Depending on the results the residual ash may require disposal at a sanitary landfill. You should define waste streams for processing with the MCU and consult with the appropriate EA representatives that have or will have jurisdiction over this aspect of “non-combustion” activities. It is recommended that the ash stream be tested periodically for known regulated compounds and disposed of consistent with local laws or EA directives. In the United States most of the residual ash streams that are produced from most combustion processes whether coal, refuse or wood fired congregation facilities are tested for at least regulated metal compounds using a leaching procedure. This has proven effective in determining the nature of the residual ash stream and how it should be disposed of or if it is acceptable for reutilization in another process.

The United States Environmental Protection Agency (USEPA), which is the equivalent of the Environment Agency, has developed a recognized ash testing procedure that is commonly used throughout the United States and by other countries around the world. This periodic testing of ash (usually performed annually) has been standard operating procedures for decades for most combustion facilities that generate municipal waste or coal ash streams, which mix bottom and fly ash inside of a combustion facility.

## 6. EQUIPMENT AND SERVICING SPECIFICATIONS

The MCU unit is equipped John Deere 4045DDiesel Engine. Engine or system consumable items and lubricants that you will need are listed in the following section:

	<u>ID Parts No</u>
Air filter - large element	AT44378
Small element	AT44377
Oil filter	T-19044
Fuel filter	AR-50041
Engine oil	20W50
Engine coolant	Low silicon anti-freeze
Bearing lubricant	NLGI Grade 2

**PORTABLE SELF-CONTAINED REFRACTORY  
AIR CURTAIN INCINERATION SYSTEM  
ABI "S" SERIES  
SUMMARY SPECIFICATIONS**

1. Power Source	Four cylinder Diesel engine, minimum 76 HP (57 kW), full enclosure; security locks around power source
2. Drive Train	Engine mounted PTO (Power Take Off) coupled to a heavy-duty 4-belt drive system.
3. Firebox	4" (102 mm) thick walls; refractory panels filled with thermal ceramic material
4. Electric System	12 Volt heavy duty battery
5. Instrument Panel	Tachometer, hour meter, ampere meter, key switch, oil pressure and water temperature gauges with safety shutdown feature and adjustable locking throttle
6. Fan	18,000 cfm (510 m <sup>3</sup> /min) centrifugal fan
7. Air Output	Minimum nozzle discharge velocity is 7,000 feet per minute (FPM) or 2,134 meters per minute with minimum nozzle discharge airflow of 760 CFM per 12" of nozzle length.
8. Manifold	Minimum ¼" (3.2 mm) steel, solid-weld assembly
9. Skid Deck	½" (12.7 mm) square tubing all solid-weld construction
10. On-board Fuel Capacity	100 gallon (378 liters) minimum fuel tank capacity
11. Transportation	Delivered to site via "low-boy" or similar trailer system
Note: Metric conversion are rounded	

## 7. EMISSIONS INVENTORY, AUTHORIZATIONS AND PROTOCOLS USED FOR THE MCU

We have yet to determine the specific process for approval of the MCU under the pending IPPC regulations. According to the EA, the new application process should be finalized and published in the very near future (30-45 days). Therefore, to illustrate proposed contents of a MCU Authorization submittal (permit) we have included a submission to the state of South Carolina, United States (southeastern seaboard) as a technical reference. The information that the EA may require is based on FOUNTAINHEADs latest meetings. This documentation is included as Attachment B. In the United States we use standard potential-to-emit (PTE) calculations based on specific waste streams to be combusted in a boiler or incinerator. These emissions rates were derived from actual field-testing or stack sampling from hundreds of installations over the past thirty years in the United States. The South Carolina permit application includes the results of the SCREEN3 air quality model. This information would be useful for potential permit applications in the UK. This model is widely used in the United States and similar air quality models are used by other regulatory agencies around the world. We also anticipate using the results of our specific air quality testing of the S-127 unit (anticipated to occur in the state of Michigan, United States in 30-45 days) to supplement this data.

Emission factors found in the permit application contained in Attachment B are frequently used for air quality analyses in the United States. (USEPA) Office of Air Quality Planning and Standards (OAQPS), Emission Factor and Inventory Group (EFIG) initially developed these factors. The AP-42 series is the principal means by which EFIG attempts to document emission factors from incinerators and industrial boilers.

Emission factors are widely cited in numerous international and USEPA publications and are representative values related to the potential quantity of a pollutant released to the atmosphere. These values are also used to determine *potential* pollutant releases from such processes as in applications such as wood furniture manufacturing operations, paint spray booths, drying ovens, as well as combustion facilities (i.e. utility boilers, industrial boilers and incinerators).

The MCU is often regulated as an insignificant source of pollution although this too varies in the United States from state to state. Federal regulations are established to set minimum standards for air quality that all states must achieve. Typically states must submit to the USEPA a State Implementation Plan or SIP defining how the state will comply with federally mandated air quality objectives. Some of the sources that produce regulated emissions are federally regulated and others are regulated under state issued permits. Some types of activities or emissions are deemed insignificant on the basis of size, emission rate, production rate or activity. State governments or regulators may exempt certain sources or types of sources from requirements to obtain permits. Any source that requires a federal permit to operate is not insignificant, even if this activity meets published air quality standards.

Numerous sources are deemed insignificant in the United States and are allowed through a simple permit process. As mentioned previously, not all major sources of air pollution in

the environment are from combustion sources yet they are usually the most politically sensitive and not all sources even if the potential to emit is minor are not insignificant. The UK and EU have similar standards as our USEPA. We use the USEPA examples since this is what we are most familiar with and over time we will hopefully be able to address specific EA or DETR issues as they apply to the MCU. Each of your situations will be unique.

Most testing for air quality compliance (in the United States) for the MCU has not been required except for opacity (i.e. visible smoke that is emitted from the MCU during the combustion process). Opacity is a reliable measure of visible emissions or particulate emissions although this scheme is not as widely used in the UK as in the US. If there is “excessive” opacity readings from a stationary source (in excess of 35%) then it is quite likely that the source is likely emitting particulate and other pollutants into the atmosphere at a rate generally determined to be inappropriate. This in part is based upon an understanding of air quality impacts associated with a specific process, related long term risk factors and other environmental considerations that have been historically documented during the development of opacity standards (in the United States). There may be other potentially hazardous air pollutants (HAP’s) emitted as well but for this example we are discussing only particulate emissions.

There are no known or suspect hazardous air pollutants emitted from the MCU from burning of untreated wood waste, pallets, joist flooring etc. or herbaceous wastes. Once again there is a USEPA approved method (Method 9) for determining opacity in the field. Semi-annual certifications are required in order to perform this testing. States or local authorities determine allowable opacity levels and these are usually stipulated in conditions of operating permits. If opacity limits are relatively low then particulate emissions will necessarily be low. Governments and air quality professionals use opacity standards as an indication of good combustion. In authorizations of the MCU using waste wood as a fuel opacity limitations infer that related compliance standards (in this instance, PM, No<sub>x</sub>, CO and So<sub>x</sub> emissions) are likely at or below permitted air quality standards. This is why regulators require opacity limitation in permits or authorizations of the MCU and not extensive monitoring or excessive testing. Regulators always have the option to require specific testing if opacity limitations in the permits are excessively exceeded.

As discussed previously, opacity is commonly used, as a measure of compliance for the MCU since the major impact associated with the combustion process is particulate matter or PM. An emission factor of 7.2 pounds per ton of waste wood processed is an AP-42 emission rate that is used for wood fired boilers. Estimated PM rates for the Whitton Technology S-127 MCU on an hourly basis are estimated at approximately 5 pounds per hour.

The S-Series has been documented to process 15 tons per hour of low moisture wood waste or 120 tons per day (TPD). If this rate is assumed for 365 days per year 24 hours per day using an “*annual maximum approach*” and applying it to the S-127 (operating 8,760 hours per year) processing 120 tons per day the *potential to emit* would be an estimated 21.9 tons per year of PM. If this were expressed in a methodology that uses pounds per year than the annual maximum PM emission rate would be 0001.

A more realistic approach is to assume that the S-Series would operate five days per week 52 weeks per year or 260 days per year. It is assumed that the MCU would operate 10 hours per day or 2,600 hours per year. This would be the annual maximum for the S-Series following the AP-42 emission factor methodology. Fountainhead Engineering Ltd. developed a Technical Memorandum for Whitton Technology discussing potential to emit estimates and calculation of AP-42 emission factors. We have provided a copy of the Technical Memorandum that was developed and submitted to the government of Malaysia Department of Environment to support the completion of the development of the authorization to install/operate a Whitton Technology T-350 and an S-121 is included as Attachment C.

Typically stationary combustion sources in the United States require the performance of a USEPA “stack test” as a condition for achieving an operating permit. One approved method used in the United States for documenting compliance with permit requirements is referred to as USEPA Method 5. This initial source testing provides a record of how the source (or technology or process) is performing in relation to established air quality regulations found in the facility’s operating authorization. Typically a construction or authority to construct permit is applied for initially. This first phase of the application or authorization process explains the process or combustion process presents information on the air pollution control technology and illustrates potential to emit calculations and related environmental or procedural aspects of the proposed installation consistent with federal and state laws or regulations and applicable local requirements. After the construction permit is reviewed by the regulating authorities is approved or denied. Often there are requests for additional information during this first phase of the approval process. If the stationary source (or technology) has completed the requisite forms and illustrates potential compliance with published standards the facility is granted “operational status”. It is during the initial operating period that the facility undergoes “compliance testing” to verify information contained in the first phase of the application (the construction permit). In most instances in the United States, the primary pollutant sources are Particulate Matter,  $\text{NO}_x$ , CO and  $\text{SO}_2$ . However the S-Series is a combustion device that does not have a stack. Therefore a variation from the USEPA reference test method (Method 5) may be required if the MCU is to be permitted under incineration rules, which some states in the United States may require due to the absence of a regulatory framework for this innovative technology. This may in fact be the case in the UK as well. The S-127 is a unique combustion device.

Method 5 as discussed previously is used to establish regulatory compliance with emission limitations set forth in the operating authorization using a consistent, recognizable, reproducible field testing method. Method 5 uses a probe that is installed into a smokestack to measure PM and other exhaust gases prior to existing into the atmosphere.

The modified Method 5 that we have developed for the MCU uses a special sampling probe that is constructed for obtaining reliable data from an unconfined combustion device or a combustion unit without a stack. A cylinder approximately 18” wide and 60” in length is fabricated with straightening vanes located at the bottom. The cylinder is attached to the air sample probe in order to confine the flow of combustion gases over the air curtain across the top of the combustion area or chamber. This represents the best approach for

measuring field or operating conditions and the effectiveness of the air curtain under normal operating conditions “in-the-field”. The straightening vanes cause more laminar airflow and essentially have the same flow and pressure relationships since the air flow will not be going around the cylinder or “mobile stack” sampling device but will be traveling vertically where the probe can extract the requisite air sample for analysis. Using this approach the testing will be isokinetic, which is consistent with Method 5.

Other proposed methods for compliance testing have been suggested. A temporary enclosure or “hood” over the MCU was proposed. The hood in theory would force the gas and particulate streams into a single stack for testing. However, after technical review of this approach it was determined by regulatory agencies that *if* the MCU was *required* to undergo performance testing it should replicate actual operating conditions with only the actual equipment needed for normal operation. Obviously the hood is not a standard feature of the MCU and the hood could potentially change the characteristics and/or effectiveness of the MCU operating systems. The use of a temporary hood although convenient for providing a static location for extracting stack samples was theorized to have the potential to reduce actual emissions since potential emissions could be generated over the entire surface area of the air curtain. Others argued that this approach would not accurately reflect the efficiency of the primary (particulate) controlling device, which is the air curtain. Therefore the modified Method 5 provides for multiple samples obtained across the top of the combustion area where the air curtain is operating.

A sampling grid is established across the entire combustion chamber and the sampling probe device is placed above the air curtain at 12 separate locations in order to acquire the initial data. There are three events or “rounds” of sampling conducted at each sample point along the grid. Each event or run is approximately one hour in duration. This approach has been used to measure hazardous passive emissions from acid baths or other similar industrial applications that discharge into the atmosphere but have a large surface area without “a stack”. In addition some industrial applications have very large diameter stacks that require multiple stack sample locations, which are performed over a grid system in order to, obtain accurate measurements. We have proposed sampling that consists of obtaining 12 separate samples that are composites, which represent the actual emissions of the unconfined combustion device above the air curtain. This procedure is repeated two additional times to insure complete data collection at all sample locations. Up to a total of 36 samples can be analyzed.

## **8. ANTICIPATED PROCEDURES FOR SECURING APPROVAL-AUTHORIZATION IN THE UNITED KINGDOM**

The MCU is new technology in the UK. There have been preliminary meetings conducted with the Environmental Agency (EA) in 1999 and 2000. In May 2000 FOUNTAINHEAD conducted a meeting with the EA and discussed at some length this specific technology, the lack of a specific “approval” regime and the fact that the current authorization process (IPC) will be replaced by the IPPC. It was clear that the ACD will be subject to the IPPC authorization process. The issues that any Consortium member will need to address will be similar to the issues in the United States since the air quality regulations in the UK are similar and there does not appear to be a clear procedure for approving the MCU at this

time. The MCU is neither a boiler nor incinerator it is a combustion device. We will need to seek approval on an MCU and provide assistance to the authorizing agency in order to have a fair and technically correct evaluation of the MCU to insure the appropriate level of regulation.

We are hopeful that an additional “field event” may not be necessary (to the EA) and that if feasible EA representatives could attend the anticipated emissions testing to occur in the United States. A demonstration test in the UK may still be required. We will be examining alternatives during the next few months and hopefully will report back to Consortium members the results of our continued regulatory efforts with the EA and the schedule of the emissions testing in the United States.

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