**RESSANI TECHNOLOGIES, LLC.**

# CONTINUOUS PYROLYSIS SYSTEM FOR MEDICAL WASTE DESTRUCTION

DRAFT

## PROCESS AND EQUIPMENT DESCRIPTION FOR EPA REVIEW AND DETERMINATION

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## INTRODUCTION

The processing of medical waste using pyrolysis has been shown to render the waste sterile and unrecognizable. The turbulence in the process is significantly lower than that found in incineration processes, thus reducing some of the emissions. There is a much greater control of temperature throughout the process reducing temperature excursions and some of the other potential emissions (also reducing maintenance and leading to more reliable operation).

The acceptable pyrolysis process has been defined in 40 CFR 60 & 62, Section 82.14490 as follows: "*Pyrolysis* means the endothermic gasification of hospital waste and/or medical/infectious waste using external energy." Thus the equipment must have an external heat source and must exclude air from the pyrolysis process area.

This document was created to show how the continuous pyrolysis system developed by Ressani Technologies will meet the above definition of Pyrolysis.

## PROCESS

The pyrolysis system is preheated prior to the start of waste processing. The oxidation chamber is preheated with a standard industrial burner firing a gaseous fuel or by plasma gas which is heated by electricity. The oxidation chamber is preheated to 1,800°F (982°C).

The pyrolysis chamber is preheated with hot gases flowing through sealed tubes that pass through various parts of the pyrolysis chamber. These hot gases can be generated by the combustion of a gaseous fuel, by electric power, or they can be recycled flue gas from the oxidation chamber. The heat transfer design is impervious to these gases and they can not enter the chamber directly. All heating is done indirectly without the introduction of any possible source of oxygen. The pyrolysis chamber is preheated to a temperature in the range of 800°F (427°C) to 1,500°F (816°C), depending on the specific requirement of the material being processed.

After the preheat temperatures have been reached, the waste, which is received in boxes with liners or in double bags, is placed into the loading hopper by the operator or by automatic conveyor. The loading hopper lid closes and the loading hopper is purged with a non-reactive gas (no oxygen) i.e.: steam or nitrogen. The purge gas carries away oxygen from the loading hopper space. The vented gas from the loading hopper is ducted to the oxidation chamber to assure the destruction of any pathogens.

The double door leading into the pyrolysis chamber opens at a preset cycle point and the waste is mechanically moved into the pyrolysis chamber. The door closes and any pyrolysis chamber gases that have flowed back into the loading hopper are vented to the oxidation chamber for destruction.

As the waste reacts to the heat in the pyrolysis chamber, moisture is driven off and then hydrocarbon gases are driven off. Plastic materials in the waste mix will shrink and distort. As subsequent loads are injected into the chamber, the total mass along the heated hearth is moved forward. At intermediate points in the chamber there are mechanical devises to continue the motion of the pyrolysis material along the hearth. These mechanical systems function through packing glands to prevent the infiltration of oxygen into the pyrolysis chamber.

As the heat drives the volatile hydrocarbons out of the waste, there remains only a mixture of ash and carbon at the end of the end of the chamber. This residual falls into the removal system that works through an airlock system to remove the residue without the introduction of oxygen into the chamber.

As the pyrolysis gases leave the pyrolysis chamber, they flow into the oxidation chamber. Air is injected into this chamber to combust the pyrolysis gas. The chamber is designed to create adequate turbulence and time at temperature to complete the highly efficient combustion of the hydrocarbon gases. Energy is put in through the burner as required to maintain the 1,800°F (982°C) temperature during normal operation.

The exhaust gases flow through a heat exchanger and are cooled below 400°F (204°C) prior to entering the dry scrubber system where pollutants are removed. The exhaust gases leave the dry scrubber system and are drawn into a blower that moves all the gases through the system and discharges the cleaned gases to atmosphere.

## DESIGN FEATURES

This section will address the specific design areas that could be potential sites for oxygen entry into the pyrolysis process. They have been designed to prevent air leakage and infiltration.

<u>The Loading Hopper</u> is completely sealed when the loading hopper lid is closed. The lid of the loading hopper has a silicone rubber gasket that gives a complete seal to the opening when it is closed. The lid is kept under constant pressure when it is closed. The purge gas entrance and exit is based upon its relative density to air. The entire loading system is completely air-tight in design so that no air can leak in while the mechanical components are in motion during the loading cycle.

<u>The Pyrolysis Chamber Door</u> is a double door design. The door towards the pyrolysis chamber is built to withstand the high temperatures of the chamber without distorting

and binding. The door towards the loader chamber is designed to be air-tight in the closed position. This prevents air infiltration when the loading hopper lid is open. It also creates a door that has much greater, long-term, operating reliability.

The Heat Transfer Surfaces are fabricated from high temperature materials with no openings into the pyrolysis chamber. This allows the flow of hot gases from any source to be used to heat the chamber with no flow (and thus no oxygen) into the pyrolysis chamber. The selected materials and the design of the heat transfer surfaces are based upon the temperature requirements, the contact relationship to the waste materials, and the mechanical activity in the area where the surface will be located.

The Residue Removal System can take several forms. It can use a mechanical seal with non-reactive purging or it can use gravity into a water sealed component. In both cases air is excluded from the pyrolysis chamber and the residue is conveyed to a container for final disposal. Part of the selection process for residue handling depends upon the requirements of the final disposal location.

## CONCLUSION

Our product development team has more than 50 years of experience in the design and construction of industrial furnaces, incineration systems, and pyrolysis systems; as well as construction and operation of medical waste treatment facilities.

The design of this pyrolysis equipment will allow continuous pyrolysis of medical waste with long term performance reliability. The concept of using the pyrolysis process in conjunction with the precise control system incorporated in this design yields continuous, precise process control with the generation of minimum emissions.

It will completely meet the definition of pyrolysis and thus, should be exempt from the “Hospital, Medical, Infectious, Waste Incinerator” (HMIWI) regulations.