(AR-18J)

Paul Dubenetzky, Chief
Permits Branch, Office of Air Management
Indiana Department of Environmental Management
100 North Senate Avenue
P. O. Box 6015
Indianapolis, Indiana 46206-6015

Dear Mr. Dubenetzky:

This is in response to your letter dated January 20, 2000, to the United States Environmental Protection Agency (USEPA) regarding the definition of a "pyrolysis unit" in USEPA's regulations for hospital/medical/infectious waste incinerators (HMIWI). See, 40 CFR 60.51c. Your letter requested a determination as to whether the Packed Tower Pyrolysis System™ (PTPS™) proposed by Statewide Medical Services meets the definition of "pyrolysis" in the HMIWI regulations. Your letter included confidential information from Statewide Medical Services describing the PTPS™. This information will be placed in our confidential files. Statewide Medical Services had earlier provided information to USEPA regarding their PTPS™ in a meeting on December 21, 1999.

As you know, pyrolysis units are not subject to the HMIWI regulations. See, 40 CFR 60.32e(f) and 40 CFR 60.50c(f). In the regulations, pyrolysis is defined as "the endothermic gasification of hospital waste and/or medical/infectious waste using external energy." See, 40 CFR 60.51c. In the preamble to the final HMIWI regulations, USEPA noted that:

> Pyrolysis technology is different from conventional incineration. Because air is generally not used in the pyrolysis treatment process, the volume of exhaust gas produced from pyrolysis treatment is likely to be far less than the volume of gas produced from the burning of waste in an HMIWI. Although conventional combustion does not occur during pyrolysis treatment, there are some emissions from the pyrolysis process. See, 62 Fed. Reg. 48358 (September 15, 1997).

There are a number of noteworthy, additional differences between pyrolysis technology and conventional incineration. First,

pyrolysis technology is an endothermic reaction (absorbs heat) while combustion is an exothermic reaction (releases heat). Second, pyrolysis occurs in the presence of an insignificant amount of oxygen. Third and finally, pyrolysis has an external energy source.

As described in the information provided by Statewide Medical Services, the PTPS™ operates as follows: the unit consists of a "pyrolysis chamber" and an "oxidation chamber"; the pyrolysis chamber is used to gasify the waste material and the oxidation chamber is used to combust the gases generated in the pyrolysis chamber. The unit initially starts up with no waste material in the pyrolysis chamber. A substoichiometric mixture of natural gas and air is combusted prior to entry into the base of the pyrolysis chamber. The resulting hot gas entering the base of the pyrolysis chamber contains an excess of hydrocarbons and no free oxygen. There are no other air ports in the pyrolysis chamber. The hot gas heats the pyrolysis chamber, creates a positive pressure in the pyrolysis chamber, and "drives out" (or consumes) all oxygen in the pyrolysis chamber. At this point the device is ready to process waste.

According to Statewide Medical Services, waste material enters at the top of the pyrolysis chamber through an air-lock system and forms a randomly packed tower of waste. The waste material itself has not been treated to enhance its oxygen content and the air-lock system minimizes the amount of air entering the pyrolysis chamber. Because the pyrolysis chamber operates under positive pressure, air entering with the waste is driven into the oxidation chamber. At the top of the packed tower, the pyrolysis chamber is relatively cool. As the waste moves down the pyrolysis chamber, it is slowly heated, driving the entrained oxygen into the oxidation chamber before it can react with the waste material. As the waste moves further down the pyrolysis chamber it is further heated, gasifying the waste material. By the time the waste material reaches combustion temperatures lower in the pyrolysis chamber, there is no oxygen available for combustion. At the bottom of the pyrolysis chamber, the residue from the process, consisting of fixed carbon and other non-volatile components of the waste, is continuously removed in a water bath. Once the process begins, the pyrolysis gases can be used in place of the natural gas.

Because the natural gas (or pyrolysis gas) is pre-combusted in a substoichiometric mixture before entering the PTPS™ chamber, Statewide Medical Services claims that no oxygen is available to react with the waste material at the base of this chamber. They assert that any oxygen entering with the waste at the top of the

PTPS™ chamber either: (1) is forced into the oxidation chamber before the waste material is hot enough to react with the oxygen, or (2) reacts with the hot natural gas rather than the relatively cool waste.

Under these conditions, the USEPA reasons that there may be an insignificant amount of oxygen in the PTPS™ chamber. By theoretically preventing the reaction of the waste material with the oxygen, the waste material would be gasified endothermically. The energy used to gasify the waste material comes from the hot pre-combusted oxygen-free natural gas (an "external source" of energy).

Based upon the information and detailed specifications provided by Statewide Medical Services, USEPA concludes that the PTPS™, if designed and operated in the manner specifically described above, could meet the definition of pyrolysis in the HMIWI regulations. The reason we qualify our conclusion is because it is not clear what precise air-to-fuel ratio will result in an oxygen-free atmosphere in the pyrolysis chamber and because it appears this device could be operated as an incinerator by increasing the air-to-fuel ratio of the pre-combusted natural gas in the pyrolysis chamber.

Consequently, two demonstrations are needed to ensure that the PTPS™ operates in a pyrolysis mode on a continuous basis. First, an initial demonstration is needed to determine the air-to-fuel ratio necessary to provide an oxygen-free atmosphere in the PTPS™ chamber. If the natural gas will be replaced by pyrolysis gas, a separate air-to-fuel ratio must be determined. Second, three parameters in the pyrolysis chamber must be monitored and recorded continuously to ensure that the PTPS™ is not operated as an incinerator: (1) the air-to-fuel ratio; (2) the oxygen level; and (3) the pressure. The air-to-fuel ratio must remain equal to or lower than the ratio determined during the initial demonstration. The oxygen level must read zero before waste is introduced and must remain at zero throughout the pyrolysis process. The pressure must remain positive relative to the ambient air and relative to the oxidation chamber at all times during the pyrolysis process. If any of these conditions are not met at any time, Statewide Medical Services must notify USEPA immediately. The USEPA may subsequently reconsider this determination at that time.

USEPA will continue to monitor the performance of the PTPS™ in order to ensure that its operation is consistent with the design characteristics. Therefore, USEPA reserves the right to ask for more information (and conduct inspections) to help evaluate the

unit's performance on an on-going basis. In addition, please be aware that the PTPS™ could be subject to other Federal or State regulations and USEPA could regulate pyrolysis units in the future.

This response has been coordinated with the Office of Air Quality Planning and Standards (OAQPS) and the Office of Enforcement and Compliance Assurance (OECA). If you have any questions regarding this determination, please contact Kushal Som, of my staff, at (312) 353-5792, Rick Copland in OAQPS at (919) 541-5265 or Jonathan Binder in OECA at (202) 564-2516.

Sincerely yours,

/s/ (02/02/00)

Stephen Rothblatt, Chief
Air Programs Branch