APPLICATION FOR AN INCINERATOR BAN APPLICABILITY STATUS DECISION

State of Delaware
Department of Natural Resources & Environmental Control
Office of the Secretary

Date of submission: June 26, 2013
Project name: Conversion of Poultry Litter into Value-added Products Using a Biorefinery at Seaford, DE
Applicant's name: Renewable Oil International DE LLC

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Incinerator Ban Applicability Status Decision Application Instructions

1. Complete all parts of the application. For questions which are not applicable to your project, do not leave blank; present a statement that clearly states why the section is not applicable to your project.

2. Because all applicants' projects are different, this word document template will provide you flexibility for needed space to answer the questions. Please insert additional lines for text where needed for your application. If appropriate, attach extra pages referencing each answer by the corresponding question number.

3. Submit a complete digital copy of the application to:

State of Delaware
Department of Natural Resources & Environmental Control
Office of the Secretary
89 Kings Highway
Dover, DE 19901
Or
DNREC_SBO@state.de.us

4. Comply, if required, or as requested by the DNREC Secretary, with 7 Delaware Code, Chapter 79, Section 7902. If requested, but not completed, your application will not be considered administratively complete until this form is received.

5. Be advised that the application for an Incinerator Ban Applicability Status Decision is a public document. If this application requires you to place confidential information or data in the application to make it administratively complete, note the Delaware Freedom of Information Act (29 Delaware Code, Chapter 100) and DNREC's Freedom of Information Act Regulation, Section 6 (Requests for Confidentiality), for the proper procedure in requesting confidentiality.

PART 1

CERTIFICATION BY APPLICANT

I hereby certify that all the information contained in this Delaware Incinerator Ban Applicability Status Decision Application and in any attachments is true and complete to the best of my belief.

I hereby acknowledge that all information in this application will be public information subject to the Delaware Freedom of Information Act, except for clearly identified proprietary information agreed to by the Secretary of the Department of Natural Resources & Environmental Control.

Phillip C. Badger for Renewable Oil International DE LLC
Print Name of Applicant

Phillip C Badger
Signature of Applicant

Partner and CTO
Title

June 26, 2013
Date

PART 2

APPLICANT INFORMATION AND SITE IDENTIFICATION

2.1 Identification of the applicant:

Company Name: **Renewable Oil International DE LLC**
Parent Company:
Address: **9447 Ginger Lane, Suite 2, Seaford, DE 19973 5697**
Telephone: **302-629-5131**
Fax:
Website: **www.renewableoil.com**

2.2 Primary contact: Please list the name, phone number and email of a preferred contact within your company in case DNREC needs to contact you regarding this status decision:

Phillip C. Badger, CTO, Renewable Oil International DE LLC
Cell Phone: 256-762-2886
Email: pbadger@renewableoil.com

2.3 Site of proposed project (if different than above), including a map of the site and surrounding area:

ROI Seaford Facility
9447 Ginger Lane, Suite 2
Seaford, DE 19973-5697

2.4 Authorized agent (if any):

Name: N/A
Address:
Telephone:
Fax:
E-mail:

If you have an authorized agent for this status decision process, provide written authorization from the client for being the authorized agent.

2.5 Is the applicant claiming confidentiality in any section of their application?
No

If yes, see instructions on page 3, item 5.

PART 3
Renewable Oil International DE LLC, Biorefinery PDU PROJECT SUMMARY

As described in Section 4.1, ROI DE has developed **fast pyrolysis biorefinery technology** that can convert poultry litter, woody materials, and other carbon-rich feedstocks into biochar, liquid fuels and chemicals, and a syngas. This project is to operate a 20-dry lb/hr (input) biorefinery Process Development Unit (PDU) at the company's Seaford Research facility for purposes of R&D, demonstration to potential clients, and for testing various feedstocks.

The feedstocks would include clean, non-hazardous organic materials such as poultry litter, grass and tree crops and their harvesting and processing residues (e.g., straw), wooden pallets, tree trimmings, etc. The feedstocks would be stored indoors and brought to the biorefinery by ROI DE personnel either in small trash dumpsters (e.g., as used for residential trash pickup) or in bales. If necessary, the feedstocks would be reduced in size with a Wylie mill, and then dried to at least 10% moisture content.

Additionally, ROI plans to manufacture their biorefinery systems at their Seaford facility. These systems could range in size up to 50 tons of input per day. Before shipping them to the company's customers, ROI would conduct commissioning and shakedown of these plants with intermittent operations over a period of one to four weeks.

The **environmental benefits** from deployment of the ROI DE technology are numerous. With the exception of most of the nitrogen in poultry litter, the nutrients are captured in the biochar (biochar derived from poultry litter has about 3% nitrogen). Since any inorganic (ash) component of the feedstock will end up in the biochar, the yield of biochar will partially depend on the inorganic content of the poultry litter, which can vary widely. Poultry litter ash values in the range of 15-20% are typical, but can be as high as 50%.

The substantial growth of the industry and subsequent water pollution problems from land application of poultry litter, especially in the Delmarva Region, are now forcing regulators to restrict land application of the poultry litter in MD, and DE is anticipated to follow suit. In addition to concentrating the nutrients in the biochar, the biochar density can be increased by pelletizing it, thus further enhancing the cost effectiveness of transporting it. The ROI DE technology thus provides a means for cost effectively recycling phosphates and other nutrients and moving them to areas that can use these nutrients.

Where the nutrients are needed and depending on initial soil conditions, land application of biochar can improve general soil health, reduce soil emissions of greenhouse gases (e.g., methane and nitrous oxide), reduce nutrient leaching, reduce soil acidity, increase soil water holding capacity (reducing irrigation requirements), and increase plant nutrient uptake (reducing fertilizer requirements by up to half)[1]. Soil water holding capacity is important in soils with low water-holding capacity. Fertilizer reductions are important to minimize the need for providing plant nutrients and the associated potential run off of nutrients, and to keep the poultry industry competitive in a global economy.

Roughly half the carbon in the poultry litter or from green plant-derived feedstocks stays with the biochar product. Thus in addition to the aforementioned benefits, land application of char provides a simple method for long term (centuries or millennia) sequestration of carbon—thus making the ROI DE process carbon negative. According to the Intergovernmental Panel on Climate Change (IPCC), the use of biochar is a key technology for reaching low carbon dioxide atmospheric concentration targets.[2] According to the International Energy Agency (IEA) and the Organization for Economic Co-operation and Development (OECD), "*Achieving lower [atmospheric CO2] concentration targets (450 ppm) depends significantly on the use of bio-energy with carbon capture and storage.*"[3]

In addition to land application, the biochar can be used to absorb pollutants in gas or liquid streams and has a special affinity for metal ions. The U of MD has expressed interest in using biochar in stormwater catch basins to capture pollutants from non-point sources. Activated biochar can be used by industry and power generating plants to capture VOCs, mercury, and other pollutants. "*New regulations in the US are forcing power plants to reduce mercury by 90% ...In the US, it is likely that the purchases [of activated carbon] by power plants for mercury removal will exceed all other environmental purchases*[4]." The University of Florida added biochar to a water-and-phosphate solution and mixed it for 24 hours. The biochar removed about three-quarters of the phosphate, which was much better

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[1] See International Biochar Initiative website at http://www.biochar-international.org/sites/default/files/Poultry_litter_final_2012.pdf
[2] http://en.wikipedia.org/wiki/Bio-energy_with_carbon_capture_and_storage
[3] http://en.wikipedia.org/wiki/Climate_change_mitigation_scenarios
[4] McIlvaine, Robert, 2012, Adsorption and Absorption, *Chemical Engineering*, pp20-22

than that removed by other compounds, including commercial water-treatment materials. The phosphate-laden biochar can also be applied directly to soils as a slow-release fertilizer.[5]

PART 4

PROJECT INFORMATION

4.1 Explain in detail the technology proposed for this project. Provide the manufacturer's information including a contact for the vendor and if the technology has been used or is in use anywhere else (if so, please provide the location and a contact person). Please provide as much detail as possible.

ROI DE has developed **fast pyrolysis biorefinery technology** that the company desires to use to convert poultry litter and wood feedstocks into value-added products in the form of biochar, liquid fuels or chemicals, and a syngas. Fast pyrolysis processes are distinguished by the following characteristics:

- Reactions occur in the absence of oxygen,
- The process requires operating temperatures in the range of 750 to 1000 ^{0}F,
- The feedstock must be heated to process temperatures within roughly one second,
- The resulting vapors must be condensed within roughly two seconds.

Although there are different methods to accomplish these process conditions, the patent-pending ROI DE process uses a solid state heat carrier in the form of small, inert ceramic balls to heat the feedstock. In practice, the heat carrier is heated to the desired process temperatures and then mixed with the feedstock in an enclosed vessel to cause virtually instantaneous decomposition of the feedstock into biochar, liquid products, and a syngas. If required, preparation of the feedstock typically involves drying to less than 10% moisture content and reducing particle size so that the maximum thickness is no more than 1/16-inch (1.5mm).

The ROI DE fast pyrolysis technology has been under development for over 10 years. The process does not consume water or generate wastewater, operates at atmospheric pressure, and does not use a boiler. Both the liquid products and biochar are biodegradable.

Typically the biorefinery includes a dryer since the feedstock is usually obtained at moisture contents greater than 10% and the fast pyrolysis process has excess heat available. There is normally enough excess heat from the fast pyrolysis process to dry feedstocks with up to 30% moisture content, which is typically the maximum for poultry litter. The dryer technology most often used for poultry litter is a rotary drum dryer.

The ROI DE biorefinery technology was obtained from Renewable Oil International LLC, a company chartered in DE in 2001. ROI presently has a plant in AL capable of processing 2.5 dry tons per day of feedstock. The contact person for the AL plant is Phillip Badger, pbadger@renewableoil.com, cell 256-762-2886.

4.2 Provide an inclusive list of all materials and waste to be used as a feedstock in the process. Include information such as where the material and waste are generated, the process by which they are generated, how they will be transported to the site, and how they will be managed while stored at the site, etc.

The main purpose of the ROI DE Seaford facility is for research, development, and demonstation. The plant is too small to be cost effective; therefore, it is operated only enough to provide research results. As part of the R&D, various kinds of non-hazardous, organic (carbon-rich) materials may be processed including poultry litter, woody materials, grasses and straws, wooden pallets, etc. A typical research run processes 20-30 lb of material and lasts for 2 to 3 hours.

[5] http://eponline.com/articles/2011/05/18/biochar-more-effective-cheaper-at-removing-phosphate-from-water.aspx

These materials will be obtained from various sources in small trash dumpsters (e.g., as used for residential trash pickup) and stored indoors in the same containers. Transportation will either by common carrier or by ROI trucks and trailers.

4.3 List any by-products, co-products, and wastes generated as a result of this proposed process and how those by-products, co-products, and wastes will be handled.

Products generated from the process are shown in the table below. Yields are based on dry weight of feedstock into the process. All incoming feedstock is processed into one of these three products without waste.

Product	Wood	Poultry litter*
Biochar	20-30%	35-45%
Bio-oil distillate	55-65%	35-45%
Syngas	10-15%	8-10%

*The amount of biochar and generated will depend heavily on the inorganic (ash) content in the feedstock. Any inorganic feedstock content will come out with the biochar. Since only organic components are distilled, higher inorganic contents will reduce the amount of distillate produced. The yields here assume an ash content in the feedstock in the range of 15-20%.

Liquid products will be stored in sealed glass, plastic, or stainless steel containers. The biochar will be stored under cover in sealed metal containers away from ignition sources and high temperatures.

The syngas cannot be readily stored and it will be either be vented or, since it is combustible, burned to provide process heat. See answer in Section 4.5 below.

4.4. Does the proposed project meet any of the following exemptions?

4.4 a Is it a Crematorium? No

4.4 b Is there disposal of the bodies of animals? No

4.4 c Is there burning of poultry waste or poultry manure at the same site where the waste or manure was generated, which shall include the burning of poultry waste or poultry manure generated upon an adjacent farm?

Poultry litter is not combusted, burned, or incinerated as part of this process. The conversion process occurs in the absence of oxygen.

4.4 d Is there disposal of materials used in the discovery, development, and manufacture of veterinary products, medicines and vaccines? No

4.4 e Is there the disposition of mortalities from poultry operations in facilities approved by the Delaware Department of Natural Resources and Environmental Control which comply with United States Department of Agricultural Natural Resources Conservation Service Interim Conservation Practice Standard Incinerator 769 or any successor standard?
No

4.5 Is there combustion or oxidation in any part of your process? If so, please provide a summary of the combustion/oxidation process.

There is no combustion or oxidation as part of the fast pyrolysis process. However, the fast pyrolysis process needs a heat source. This heat can come from another co-located process (e.g., a power plant), from electric heaters, from fossil fuels, solar energy, or other sources. One co-product of the fast pyrolysis is syngas, which in the case of poultry litter represents no more than 10%wt of the dry feedstock input into the process. This syngas is combustible, cannot be cost effectively stored, and relative to fossil fuels is carbon neutral. The combustion of this syngas would result in fewer emissions then simply venting it and would offset the use of non-renewable fossil fuels. Therefore, the use of this syngas to provide part of the thermal energy for the process seems in the best interests of everyone.

4.6 At any point in your process, is oxygen (O2) a necessary component? If so, please explain.

See answer to question 4.5

4.7 Is every point on the property boundary line of the property on which the proposed project is to be located at least 3 miles from every point on the property boundary line of any residence, church, school, park, or hospital?

There are residences and at least one church within three miles of the proposed site.

4.8 Explain why your process does not involve the combustion (oxidation) of solid waste and is exempt from the "incinerator ban."

As explained previously, the fast pyrolysis technology converts feedstocks into biochar, liquid products, and a syngas in the absence of oxygen.

Furthermore, the implementation of the ROI biorefinery would provide cost-effective solutions to a number of environmental problems in DE.

END OF APPLICATION

ATTACHMENTS TO FOLLOW

MAP OF PROPOSED SITE

ROI Seaford Facility
9447 Ginger Lane, Unit 2
Seaford, DE 19973-5697