Delta Thermo Energy - Company Overview

Company Overview

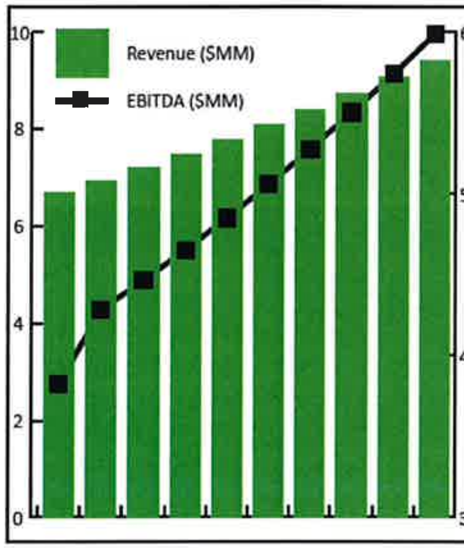
Background: Delta Thermo Energy ("DTE" or the "Company") is an alternative energy company that takes municipal solid waste and converts it into clean electricity through "hydrothermal decomposition" – an environmentally friendly way of disposing waste and generating electricity.

Location: Princeton, New Jersey

Description: As an alternative energy company DTE designs, manufactures, installs, maintains and operates alternative energy solutions using waste as fuel.

Client Base: DTE's potential customers are local municipal governments and public authorities; hospitals, army, navy and air force bases; waste management company or landfill; or utilities looking to expand their alternative energy sources.

Projected EBITDA



Investment Highlights

DTE will install and operate compact and relatively affordable plants generating low cost, clean energy using high calorific content waste and, at the same time, complying with the standing EPA regulations.

DTE has a proven complete technology solution, already operating (14,000 hours of effort and on line operation) in several facilities in the world solving the issues of waste, pollution and energy - in one system.

Factoring total costs and non-energy related revenues DTE's cost (cents/kWh) is very competitive

Federal tax incentives and tax-exempt financing available through The Energy Policy Act and the American Recovery and Reinvestment Act.

Market Overview

On municipal solid waste alone, the United States market generates more than 300 million tons annually.

The number of landfills has decreased by 78% in 22 years. Tipping fees are increasing in every region particularly in the Northeast.

Total clean-energy market could grow to $92 billion by 2013, about seven times the size of $13 billion in 2005.

The EPA's "Green Power Partnership" grew to more than 1,000 partners, who collectively purchased 16 TWh of green power annually by the end of 2008 (double of 2007).

The average US household generates between 3-4 tons of waste/year

Renewable Energy

DTE's solution handles waste without landfills reducing pollution & use of fossil fuels by reducing waste transportion.

The small footprint plants (~ 30,000 sq ft) operate at near zero emissions beating EPA standards.

DTE presents the only solution for power generation from the mixture of municipal solid waste and sewage sludge with variable mixing ratios.

Energy from waste with a high calorific content allows for the disposal of problematic waste and generates large amounts of clean energy.

Technology

Delta Thermo Energy has the exclusive rights to all components of the total "waste to energy" solution.

Hydrothermal Decomposition, our key technology is the combination of high pressure steam used to breakdown municipal solid wasteor Sludge into pulverized material with a high caloric content which in turn is burned using high temperature combustion to generate energy.

A typical plant would process 125 tons a day of wet materials, converting them into both thermal and electric energy.

Waste-to-Energy using MSW-Sludge

An Executive Overview
For the Citizens of the City of Allentown

Creating "green" energy

October, 2010

Historical Technology Perspective

Delta Thermo Energy, Inc.

1972 Chevy Impala

6.6 liters engine
Rear axle drive
23 gallon tank
3 speed auto
Lead gasoline
12 mpg

Today's Chevy Impala

3.5 liters engine
Front wheel drive
17.5 gallon tank
4 speed auto w/OD
FlexFuel
29 mpg

Historical Technology Perspective

Circa 1972 Telephone

Today's Cellphone

Delta Thermo Energy, Inc.

Historical Technology Perspective

Circa 1972 Computer

Today's Laptop

Facility Comparison

Incinerator

Proposed Look of DTE Facility

Then versus Now

Delta Thermo Energy, Inc.

Incinerator

- Very large buildings & ancillary facilities
- Incinerators occupy a large area
- Hundreds of Millions to Billions in investment
- Significant pollution
- 10s of Millions in annual costs
- Processing thousands of tons of MSW a day from different localities
- Sludge to landfills

DTE Facility

- Self-contained in 20K to 30K sq ft building
- Small combustor: 12’x15’x30’
- ~$25 Million capital costs
- Near zero emissions
- Less than $3 Million in operating costs
- Accepting only Allentown MSW ~100 tons per day
- Processing sludge ~50 tons per day – A first!
- Built in redundancy

Key Points-Environmental

- No odors
  - Wet scrubber for emissions
  - Negative-pressure building (45 feet height)
- No external plume from stack
- No use of landfills or land spraying of sewage sludge
- No use of fossil fuels to operate facility
- Near zero carbon footprint
- Principally a closed loop system
- Reduced trash truck traffic and associated pollution
- Creating new “green” jobs (~21 people)
- Creating clean “green” electricity

Delta Thermo Energy, Inc.

Key Points –Testing, Safety & Compliance Issues

- Permits
- Redundancy
- Monitoring Consultant by the City
- Material Flow Pit, Internal to Facility
- OSHA, EPA, DEP Compliant
- Contingency contract with landfill operator
- 3rd Party Vetting: Lehigh University ERC
  - Bench Scale System to be housed at ERC
- Citizens Advisory Board (CAB)
- DTE will provide both Performance and Maintenance Bonds

Key Points - Financial

Delta Thermo Energy. Inc.

- Substantial net savings to the City budget
- No changes to current City operations
- Continued City recycling operations "as is" and continue to receive the benefits

Tokyo Institute of Technology*

Delta Thermo Energy, Inc.

- **The researchers at Tokyo Institute of Technology's (TIT) Frontier Research Center* investigated and found scalable alternatives to large incinerators.**

- **Based on this research, TIT focused on the development and commercialization of new technologies for the utilization of segregated wastes as well as mixed wastes as new energy resources.**
  - The innovations covered solutions ranging from pre-treatment to final energy production.

- **Using these innovative solutions, Delta Thermo combines those technologies, some jointly developed with TIT.**

* Dr. K. Yoshikawa, Frontier Research Center, Tokyo Institute of Technology, Japan

TOKYO TECH Pursuing Excellence

TOKYO INSTITUTE OF TECHNOLOGY

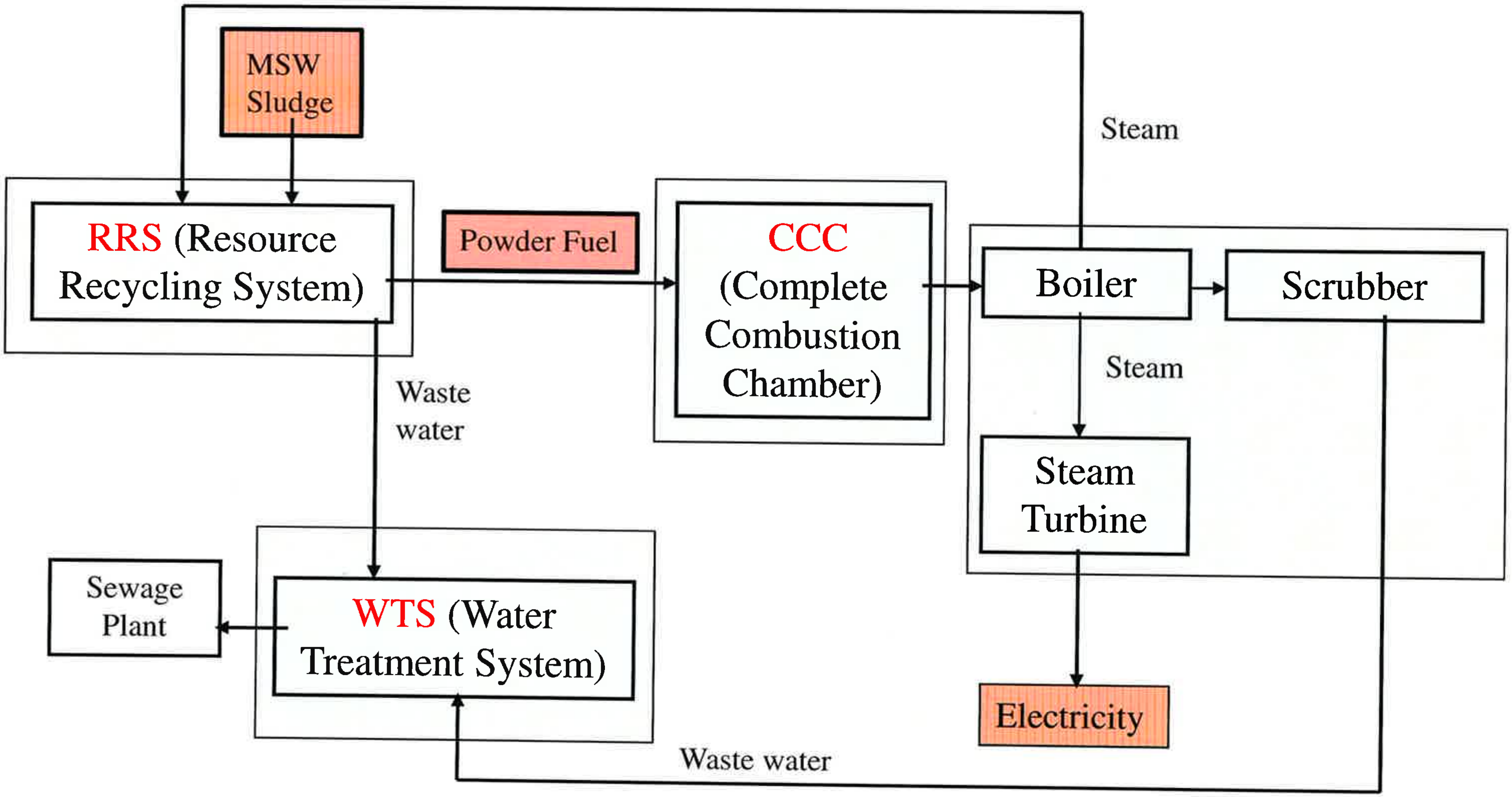
Technology Advisers

Delta Thermo Energy. Inc.

- Dr. Marco Castaldi, Columbia University; Assistant-Professor of Earth & Environmental Sciences at the Waste to Energy Institute
- Dr. Ashwani Gupta, University of Maryland; Distinguished Professor; Director of The Combustion Laboratory
- Dr. Brian Gleeson, University of Pittsburgh; Director of The Center for Energy; Harry S. Tack Chair Professor
- Dr. Kunio Yoshikawa, Tokyo Institute of Technology; Distinguished Professor of Waste to Energy at the Frontier Research Center.

Waste-to-Energy Project Overview

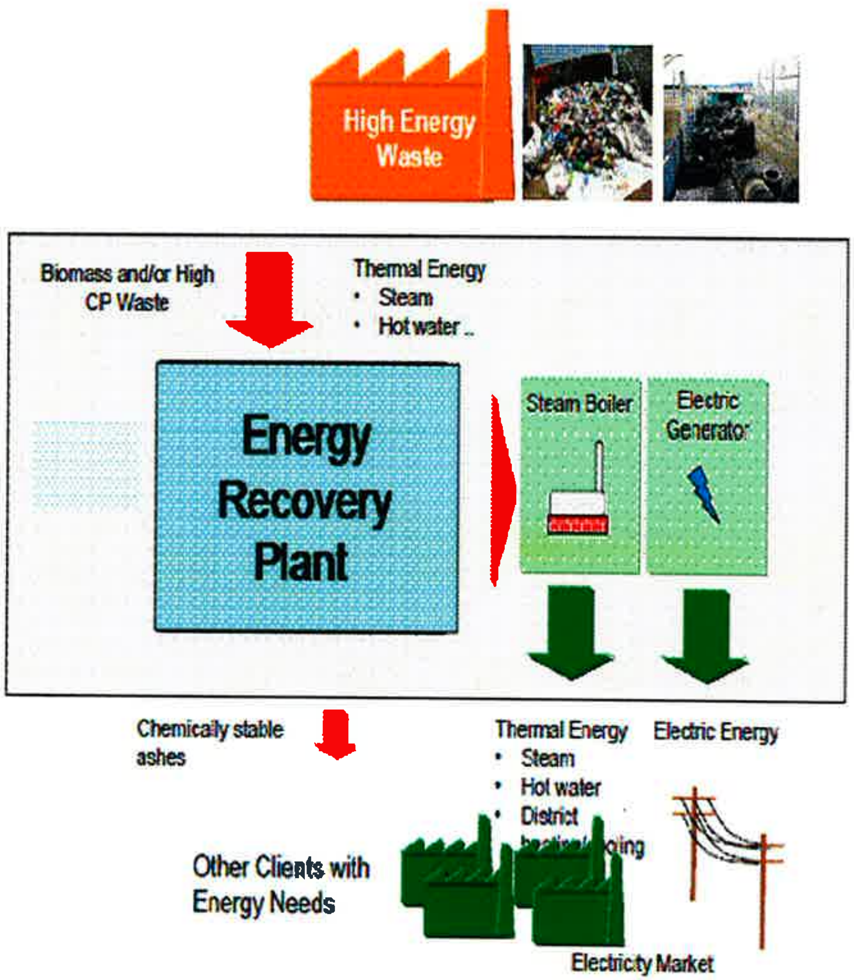
Delta Thermo Energy, Inc.



Note: DTE owns and had all needed rights to all of this technology.

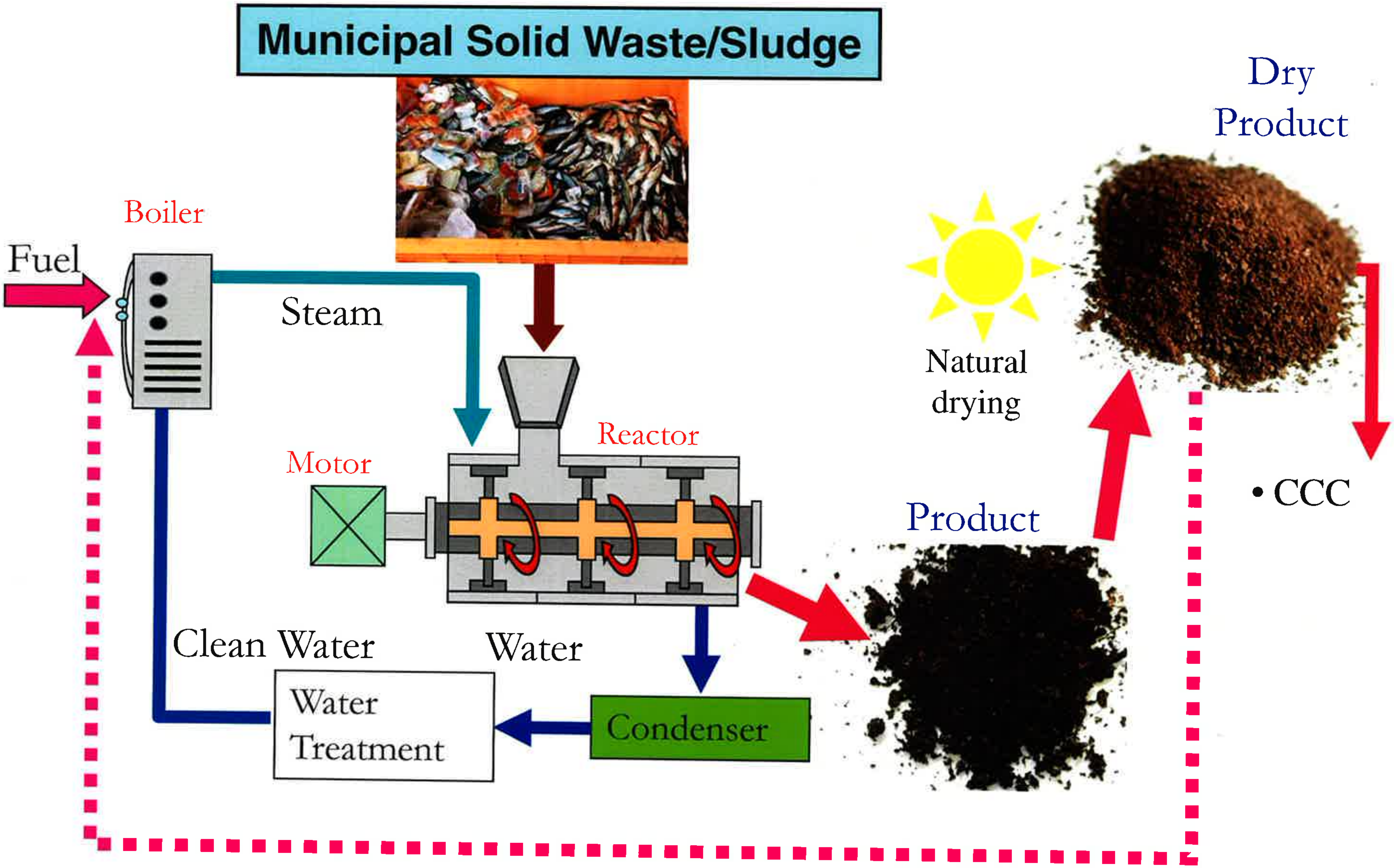
Environmentally Friendly Energy

Delta Thermo Energy, Inc.



- Renewable green "clean" energy.
- Handle waste without landfills
- Reduce pollution & use of fossil fuels by reducing transport
- Create "green" jobs for Allentown
- Small footprint
- Low capex to build the plant
- Low operating costs
- Beats EPA standards
- Economically viable
- State of the art monitoring system
- Designed in redundancy
- Contingency plan in place.

RRS - Hydrothermal Pre-Treatment



RRS Plant in Hokkaido, Japan

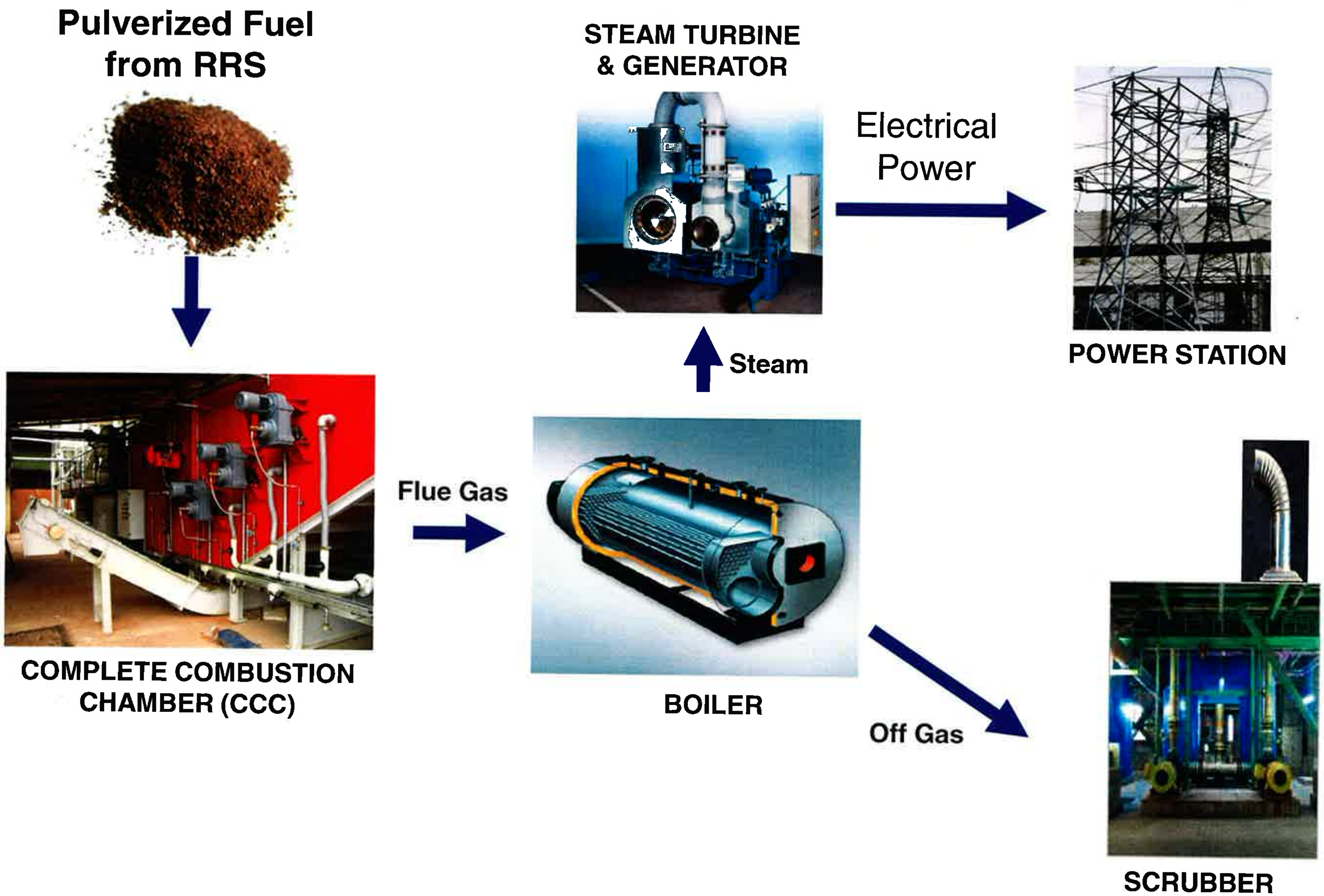
Delta Thermo Energy, Inc.






CCC to Electric Power

Delta Thermo Energy, Inc.



CCC Plant in Dresden, Germany

DTE
Delta Thermo Energy, Inc.

Key Points Summary

Delta Thermo Energy. Inc.

- No odors
  - Wet scrubber for emissions
  - Materials contained in negative-pressure building (45 feet height)
- No external plume from stack
- No use of landfills or land spraying of sewage sludge
- No use of fossil fuels to operate facility
- Near zero carbon footprint
- Principally a closed loop system
- Reduced trash truck traffic and associated pollution
- Creating new “green” jobs (~21 people)
- Creating clean “green” electricity
- Substantial net savings to the City budget
- No changes to current City operations
- Continued City recycling operations “as is”

Only Output of Facility

- **Ash from Combustion Chamber**
  - It is inert and bacteria free and can be sold to both cement and road construction companies.
- **Liquid fertilizer from Water Treatment System (WTS)**
  - Bacteria free
  - Filtered and thoroughly cleaned by WTS
  - Rich in nitrogen & nutrients to be used for land application
- **Sorted/Recyclable Materials**
  - Will be sold and sent to a recycling center for further disposal

Everything is reusable/recycled,

No Disposal Issues!

Future Manufacturing Facility

Delta Thermo Energy, Inc.

- DTE plans on locating a full scale manufacturing facility in the Lehigh Valley, Allentown to manufacture some of the key subsystems
- This facility is planned to be started within 2 years of the Allentown facility being operational
- This facility could employ up to 200 new jobs
- Everything will be manufactured in the USA for future plants
- The new jobs skills are consistent with steel industry and engineering jobs which exist in Lehigh Valley.
  - Feeding jobs to other small businesses in the area.

Citizens Advisory Board (CAB)

Delta Thermo Energy, Inc.

- DTE wishes to set up a CAB with 5-7 members of the community
- During the construction phase of the facility the CAB will meet monthly
- Once operational the CAB will meet quarterly
- The responsibilities and expectations of the members are:
  - Provide feedback to DTE on construction/operations
  - Monitor public response
  - Identify potential issues
  - Help address public concerns.

Summary of Benefits

Delta Thermo Energy, Inc.

- Makes Allentown a Leader in Alternative Energy Innovation in the Nation!
- Net 1st year savings to City: ~$4,500,000
- Net total savings to City: ~$137,000,000
- Direct economic impact to the community in 2011 to 2012: ~100 new jobs
- Eliminate environmental impact of MSW landfill & disposal of sewage sludge
- ~221 new jobs for plant & manufacturing
- "Green" energy supply to electric grid
- Rehabilitated land next to sewage plant
- Spearheading "Center of Excellence" in alternative energy

Energy Technology Perspective

There are cloudy days

Wind is unpredictable

Garbage always happens; everyday guaranteed!

Contacts

Thank You

Delta Thermo Energy, Inc.

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- marco@deltathermo.com

City of Allentown Memorandum

TO: Kenneth Bennington
Managing Director

FROM: Richard Rasch
Utility Engineer

DATE: July 21, 2010

SUBJECT: Site Observations of the Jasper GmbH CCC unit @ the Reinsberger Spezialpapier GmbH

DRAFT

In attendance:
Marco Bonilla, COO w/Delta Thermo Energy (DTE)
John Sale, ERC Engineer w/Lehigh University
Richard Rasch, City of Allentown
Robert Jasper, Managing Director w/Jasper GmbH
Dirk Willnow, Staff Engineer w/Jasper GmbH
Paper Company Owner & staff

On July 14th, the representatives visited the Reinsberger Paper Company to review and observe the operation of the Jasper GmbH Complete Combustion Chamber (CCC) unit, which provides stream energy to the paper processing operation at the plant.

Unfortunately, during our visit the unit was shut down and under repair. The plant had to fire up their oil burning unit to stay operational during this period. We were unable to observe the CCC units operation this day, since the repair took some 4 hours to perform. It would also take another 5 hours to fire up the CCC to full operational status. The shutdown consisted of repairing a fuel feeder clutch mechanism. However, due to the shutdown, we had the rare opportunity to take a look inside the primary combustion chamber of the CCC unit to observe the internal mechanisms. Due to proprietary concerns, I prefer not to elaborate on this item.

As per our visit to the above Paper Plant, here are a number of items I observed at the site on this date:

1 The stored fuel product was shredded & mixed paper and presorted municipal solid waste (MSW), which was wrapped and encapsulated in plastic and was stored on pallets along the driveway entrance.

2 The above material was unwrapped and dumped into a large metal dumpster with a retractable lid. Standing directly above and adjacent to the dumpster, shredded fuel product in the dumpster had a mild trash odor when the lid was in the open position. At one point, I could smell a fishy odor. However, when the dumpster lid was closed the odor had diminished. Ten to twenty feet away from the dumpster, the odor was not observed.

3 The bottom ash system was discharging a wet ash by product, which had no odor. Water was added to eliminate any dust that is associated with conveying the ash to the ash storage bin.

4 With the access door to the primary combustion chamber open, the mechanical mixing and aeration system within the interior of the CCC was observed.

5 The CCC unit has an emergency gas vent, which is on top of the main combustion chamber. An item not shown on the previously submitted drawings. For safety reasons, the vent was added to the CCC unit; should there be an immediate shut down of the steam boiler or other downstream equipment.

6 Protection from the weather: It was interesting to note the make shift roof provided for the CCC unit by the owner. In addition, no sidewalls were provided other than having partial enclosures by the existing retaining wall to one side and the existing plant building wall to the other. Therefore, the CCC at the paper plant is exposed to freezing temperatures during the winter.

On the following day, (July 15th) we revisited the plant, while the CCC unit was in operation, the following new observations were made:

1 The systematic feeding of the fuel into the CCC combustion chamber unit. The fuel was conveyed to the top of the primary combustion chamber, then small gate doors within the small hopper would mechanically open and allow the fuel to enter the chamber.

2 The computerized intermittent operation of the mechanical mixing and aeration systems within the primary combustion section of the CCC unit on an as needed basis.

3 The external temperature of the CCC unit was hot to the touch, somewhere around 120°F.

4 Odors were negligible.

5 The exhaust plume was clear and approximately 2 +/- feet above the stack. The plume was not very noticeable.

Summary:

The Jasper GmbH CCC unit will be able to burn a number of different types of fuels due to its inherent flexible design and operational methods. Most, if not, all fuels will need to be either shredded or pulverized to keep to fuel particles small enough so as not to cause jam ups within the primary combustion section of the CCC.

The CCC unit is only one component of the overall DTE waste to energy plant's design, which is proposed to be installed in the Lehigh Valley. Designing the overall plant to work harmoniously with the other plant components is the final ingredient to make the plant function to its true potential.

The CCC unit should easily meet or exceed Government emission requirements and should have a very negligible impact on the environment. Use of the CCC unit will reduce the shipments of waste(s) to the landfill and will provide power (electrical) from waste materials that otherwise would have been produced from either nuclear or fossil fuels.

The waste-to-energy plant will need to be designed to compensate for periodical maintenance shutdowns for the CCC unit.

Energy Research Center
Lehigh University
117 ATLSS Drive
Bethlehem, PA 18015

Telephone: (610) 758-4090
Fax: (610) 758-5959

October 15, 2010

MEMORANDUM

TO: The Honorable Edward Pawlowski, Mayor, City of Allentown, PA

FROM: John Sale, Lehigh ERC

RE: **Jasper GmbH Complete Combustion Chamber (CCC) System Technical Review**

LETTER REPORT NO: 10-400-10-11

1. ABSTRACT

On July 14th and 15th, an engineer from the Lehigh University Energy Research Center (ERC) visited the Reinsberger Spezialpaper GmbH, paper plant which is located at Muldenweg 1, 09629 Reinsberg, DE, to inspect a Complete Combustion Chamber (CCC) system manufactured by Jasper, GmbH (Jasper). The purpose of the visit was to observe the operation and learn more about the technical features of the CCC system and associated equipment from the Jasper owner and staff engineer.

The Jasper CCC is a variation on stoker-fired boiler design. Stoker-fired boilers use fuel feed systems such as moving or vibrating grates. These systems use a combination of feed speed and air injection systems (over and under-fire air) for combustion. Traditional stoker-fired boilers have relatively low combustion efficiency due to the problems associated with getting sufficient air into the fuel bed for complete combustion. The author's initial assessment of the CCC technology is that it is a viable alternative to a traditional stoker-fired boiler and should provide improved combustion efficiency and lower emissions. After review of the overall proposed Allentown facility fuel supply and preparation strategy, the Jasper CCC fuel feed system appears to be an acceptable method for the project.

The design specifications for the waste heat boiler and flue gas cleaning systems has not yet been prepared. However, Jasper GmbH has said that this will be done once the detailed fuel type, quantity and quality is finalized. This information will also be used to prepare the detailed mass and energy balance for the plant.

2. INTRODUCTION

On July 13th and 14th, an engineer from the Lehigh University Energy Research Center (ERC) visited the Reinsberger Spezialpaper GmbH, paper plant which is located at Muldenweg 1, 09629 Reinsberg, DE, to inspect a Complete Combustion Chamber (CCC) system manufactured by Jasper, GmbH (Jasper). The trip was coordinated by Robert Van Naarden and Marco Bonilla of Delta Thermo Energy (DTE). Marco accompanied the author and Richard Rasch (City of Allentown) on the trip. The meeting in Dresden and at the paper plant was with Robert Jasper, Managing Director of Jasper GmbH; and Dirk Willnow, staff engineer from Jasper GmbH. Jasper is the supplier of the CCC and will specify the equipment for the overall waste heat recovery and electricity generating cycle that is proposed for the Allentown facility.

The purpose of the visit was to learn more about the technical features of the Jasper CCC system and associated equipment from the Jasper owner and staff engineer. An additional objective was to observe unit operation to determine if there was any adverse operating or environmental issues. Jasper has been contracted to provide an operations and maintenance manual for the CCC and DTE is willing to provide to the City of Allentown a copy of the manual for review.

3. REINSBERGER SPEZIALPAPER CCC SYSTEM OVERVIEW

The CCC system at the Reinsberger Spezialpaper plant has been in operation for about 1-1/2 years. Fuel for the CCC is pre-sorted MSW and paper that has been mixed and shredded. The fuel is prepared off-site and shipped to the paper company. The fuel is stored on-site in shipping containers and transferred, as needed, to a large CCC feed storage bin. There is some odor associated with the MSW portion of the fuel at the storage bin location. The fuel is fed into the CCC feed hopper from the storage bin using a twin-screw feeder. The feeder speed is controlled by CCC furnace temperature.

Natural gas, which is normally used for startup, is also controlled by the CCC furnace temperature. The CCC internal feeder mechanism operation, which is fuel dependent, is still being optimized by Jasper. The CCC is equipped with an emergency gas vent to the atmosphere that opens on high furnace temperature, should there be a sudden shut-down of the waste heat boiler, to prevent overheating the unit. There is very little operational noise associated with the unit.

The waste heat boiler produces 661 lb/hr (300 kg/hr) of saturated steam at 145 psig (10 bar). There is no electricity generation at the paper plant. Flue gas from the waste heat boiler goes through a dry sodium hydroxide (NaOH) reactor, then through a baghouse, and then exhausted to the atmosphere. There was a visible thermal plume at the stack; but no visible opacity.

The CCC O_2 instrument, which is used to monitor combustion air, is located at the exit of the waste heat boiler. The CCC runs with an O_2 reading of about 9-11% at

482°F (250°C). This is probably higher than necessary for good boiler combustion efficiency.

One interesting feature is an emergency dilution air inlet that is located between the waste heat boiler and the NaOH reactor. The purpose of the dilution air intake is to protect the reactor and baghouse from high flue gas temperatures in the event steam flow from the waste heat boiler is stopped.

The CCC system is controlled from an air-conditioned two-panel Siemens control system. The control panel has a touch-screen with a menu system is used to control and monitor the CCC and associated equipment.

Flue gas exhaust emissions to the atmosphere are not continuously monitored. The paper plant has a special exemption from the Saxony Regional Government because emissions are lower than the government requirements due to the fuel and combustion process used. However, the regional government still conducts stack tests twice a year to check environmental compliance.

Jasper expects a new CCC to operate about 7,500 hours operation in the first year and about 8,000 hours the second year. The CCC system was designed with sufficient redundancy to insure continued operations with a single failure. Scheduled maintenance outages are twice a year for 7 days each. The paper plant has had two unscheduled outages; one due to freeze damage to a CCC internal fuel feeder mechanism during a scheduled outage and once during our visit to adjust the fuel feeder mechanism clutch. The clutch was slipping due to the weight of the MSW on the feeder. The cause was over-feeding the fuel into the CCC inlet hopper. The duration of the first unscheduled outage is unknown. The second unscheduled outage was about four hours. Restarting the CCC after the second shutdown was about five hours.

Since the CCC was not operating during our first visit, we were able to inspect the unit internals. No unusual damage to the fuel feeder mechanisms or the ceramic tile lining was noted. The CCC internal feeder mechanisms are constructed from corrosion-resistant materials. We were told that there have been no incidences of CCC corrosion to date during unit operation.

4. PULVERIZED FUEL ANALYSIS

The author performed an independent Higher Heating Value (HHV) and Lower Heating Value (LHV) calculation from the preliminary Allentown facility fuel analysis provided by DTE to Jasper. The authors calculated LHV of 6,729 Btu/lb (HHV of 6,255 Btu/lb) was close to the LHV of 6,835 calculated by Jasper. The difference was probably due to slightly different method used for calculating the HHV of a biofuels [1]. In either case the fuel energy is consistent with the Energy Information Administration (EIA) estimated energy content for MSW of about 5,865 Btu/lb [2] and is sufficient for combustion. The EIA notes in the reference that in general, combustible non-biogenic materials are characterized by higher heat contents per unit weight than combustible biogenic materials. Thus the ration of biogenic to non-biogenic material volumes can have a considerable effect on the heat content of the waste stream.

It has been reported by DTE that the Resource Recovery System (RRS) system proposed for the Allentown facility will remove the fuel inherent moisture leaving the moisture content in the fuel as surface moisture. The fuel analysis show in the Jasper mass balance sheet (Attachment A) is the "as-received" condition from the RRS. It should be noted that it might be possible to reduce the fuel moisture content of 30% to a lower value using waste heat from the combustion cycle, which would produce an "as-fired" fuel with better combustion properties. This would raise the fuel HHV and improve combustion efficiency.

During the trip, the subject of conducting a test burn of the pulverized fuel (PF), which would be prepared from Allentown MSW and sludge, was discussed with Marco Bonilla (DTE) and Robert Jasper (Jasper). This was determined not to be feasible due to the quantity of PF that would need to be prepared in Japan (the site of the RRS demonstration system) and problems with exporting the PF to Germany. We also discussed looking for a PF in Germany that would have similar combustion properties, but none were identified by Jasper.

5. MASS/ENERGY BALANCE

Jasper has prepared a preliminary mass balance for the Allentown facility. However, a complete mass and energy balance (heat balance) will eventually be needed to conduct a cycle performance review and economic analysis. The waste heat recovery boiler and associated equipment and steam turbine cycle equipment (including the condenser cycle, and condenser cooling method) decisions and selections will need to be made to prepare this these analyses. Jasper is waiting on Allentown project-specific fuel type, composition and quantity information in order to prepare the final design.

6. FUEL SUPPLY

The Allentown facility CCC will be started using natural gas and PF. Once the system is at normal operating temperature, it will run on PF. Natural gas will be used, as necessary, to maintain a stable CCC combustion temperature.

Fuel for the CCC may initially be a combination of shredded MSW and PF prepared from sludge in the RRS. This will provide a homogeneous fuel that is similar to the fuel being used at the paper plant. Once experience is developed, the shredded MSW will be processed through a parallel RRS producing a second source of PF. Incremental adjustments will be made to the CCC operation to accommodate 100% PF operation. The CCC will have the flexibility to burn either fuel supply or a combination of the two. During certain operations, shredded MSW can be fed directly to the CCC.

DTE has shown the ERC engineers examples of the PF that has been prepared in the RRS unit that is located in Japan. There is no odor associated with the PF sample. However, particle size distribution information is not yet available for the PF.

The mixed MSW and PF prepared from sludge will be stored in a pit located between the RRS and the fuel dryer. The pit is expect to have about a 4-7 day capacity, which will allow short scheduled maintenance cycles on the CCC without disrupting the flow of MSW and sludge into the Allentown facility. The RRS and holding pit will be located in a building that has a slightly negative pressure to control any operational odor problems.

7. JASPER COMPLETE COMBUSTION CHAMBER (CCC)

PF Transport System

The PF that will be prepared in the RRS will have a slurry-like characteristic and will be stored in a holding pit. The PF will be pumped to the fuel dryer and then conveyed to the CCC based on control system demand. The conveyed fuel will then be gravity fed into the CCC inlet hopper. After review of the overall Allentown facility fuel preparation strategy, the Jasper CCC fuel transport system appears to be an acceptable method for the project.

Jasper CCC Design

The Jasper CCC is a variation on stoker-fired boiler design (Figure 1). Stoker-fired boilers use feed systems such as moving or vibrating grates to move the fuel through the combustion zone. These systems use a combination of feeder speed and air injection systems (over and under-fire air) for combustion control. Traditional stoker-fired boilers have relatively low combustion efficiency due to the high moisture content of biofuels and problems associated with getting sufficient air into the fuel bed for complete combustion. The ERC has been involved in the past with a generating company, which operated stoker-fired boilers, in the development of a patented combustion air foil. The combustion air foil penetrated the fuel bed and introduces additional air for improved combustion efficiency. The combustion air foil also provides a degree of bed mixing, which also helped improve combustion efficiency. This work demonstrated the combustion efficiency benefits of good bed mixing and air distribution in the bed.

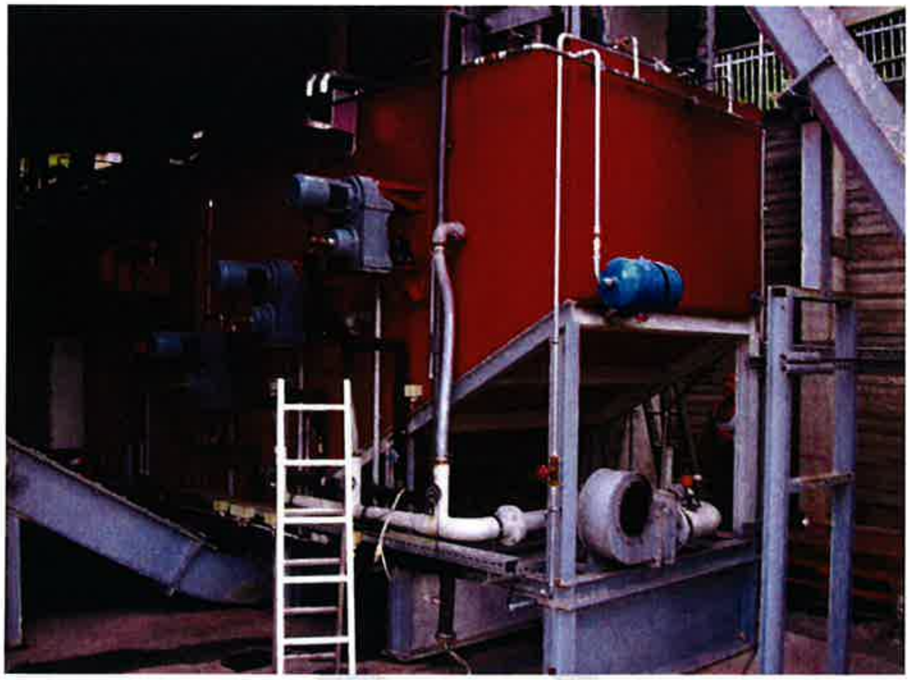

Figure 1: Jasper GmbH Complete Combustion Chamber

The Jasper CCC provides primary combustion air with the natural gas and injects secondary air at the sides of the combustion zone to the shredded MSW/PF during unit startup. The unit uses approximately 8% natural gas on an energy basis during startup. Once the unit is operating at normal combustion temperatures, the natural gas burners are shut down and all combustion air is provided through the side-air injection nozzles.

Fuel is gravity-fed into the CCC inlet hopper, which is located at the beginning of the combustion zone, and is conveyed through the combustion zone using a series of rotating feeder mechanisms. These feeder mechanisms have independent direction and speed control, which can be used to optimize the combustion process by insuring good bed mixing and residence time. This provides good fuel retention time and burn-out, which improves combustion efficiency and reduces stack emissions.

The author's initial assessment of the CCC technology is that it is a viable alternative to a traditional stoker-fired boiler and should provide improved combustion efficiency and lower emissions. Once the fuel compositions and quantities are established, a detailed combustion calculation, using accepted methods should be prepared. The results should be compared to a boiler efficiency calculation using data collected from the paper plant. This will require obtaining a typical shredded paper/MWS analysis, and bottom ash and fly ash analyses from the plant.

CCC Bottom and Fly Ash Removal

Bottom ash is removed from the paper plant CCC using a wet system (Figure 2). The bottom ash is disposed off-site. Dry fly ash at the paper plant is gravity collected from the baghouse into a fabric storage bag (Figure 3).

Figure 2: CCC Bottom Ash System

Figure 3: Fly Ash Collection System

The quantity of fly as collected from each point is shown in the Jasper preliminary mass balance. Disposal methods for the bottom and fly ash have not yet been determined.

8. WASTE HEAT BOILER/STEAM TURBINE GENERATOR

Waste Heat Boiler

The design specification of the waste heat boiler has not yet been determined. However, on review of the Jasper mass balance diagram, the gas temperature of 1922°F (1050°C) from the CCC is similar to a gas turbine exhaust temperature. This would indicate that a traditional multi-stage Heat Recovery Steam Generator (HRSG) can be used for steam generation. The waste heat boiler preliminary pressure and temperature of 464°F/302 psia (240°C/20 bar) has been established based on the RRS requirements. The total amount of steam generated will be based on the total amount of fuel processed through the RSS. Steam in excess of that required for RRS operation will be used for electricity generation using a steam-turbine generator (STG). A preliminary design of the electricity generation capability is shown in the Jasper mass balance diagram (Appendix A).

9. AIR PREHEATER (APH)

In a traditional boiler cycle, there is generally a performance and economic benefit from preheating combustion air using flue gas waste heat. However, depending on the design of the waste heat boiler, which will be used for condensate preheating and steam production, the flue gas exhaust temperature from the waste heat boiler may be too close to the acid dew point to allow usable further heat recovery. This would mean that further flue gas heat recovery for combustion air preheating might not be practical due to the potential for acid corrosion in the downstream duct work and equipment.

10. SCRUBBER

The paper plant CCC uses a dry sodium hydroxide (NaOH) system for sulfur emissions control. The NaOH is stored in a silo and pneumatically injected to a mixing chamber/reactor that is located between the outlet of the waste heat boiler and the inlet to the baghouse (Figures 4 and 5).

Figure 4: Sodium Hydroxide (NaOH) Storage Silo

Figure 5: Sodium Hydroxide (NaOH) Mixing Chamber and Reactor

A wet scrubber system is being considered as an alternative to the dry NaOH system. However, the decision on which system to be used and the detailed design requirements for the system has not yet been determined.

11. EMISSIONS MONITORING EQUIPMENT

The paper plant CCC system has a special exemption from the Saxony regional government for Continuous Emissions Monitoring System (CEMS) equipment due to the fuel and combustion process which produces low emissions levels. The only emissions monitoring requirement is a twice-yearly stack test. However, it is unlikely that a CCC system installed in the Allentown facility would get a similar exemption. It is the authors understanding that DTE is in the process of obtaining environmental permits from the Pennsylvania Department of Environmental Protection (PA-DEP). The PA-DEP permitting process will determine the type and frequency of emissions monitoring that will be required for the Allentown facility.

12. CONCLUSION

The Jasper CCC is a variation on stoker-fired boiler design. Stoker-fired boilers use fuel feed systems such as moving or vibrating grates. These systems use a combination of feed speed and air injection systems (over and under-fire air) for combustion. Traditional stoker-fired boilers have relatively low combustion efficiency due to the problems associated with getting sufficient air into the fuel bed for complete combustion. The author's initial assessment of the CCC technology is that it is a viable alternative to a traditional stoker-fired boiler and should provide improved combustion efficiency and lower emissions.

Once the fuel compositions and quantities are established, a detailed combustion calculation, using accepted methods should be prepared. The results should be compared to a boiler efficiency calculation using data collected from the paper plant. This will require obtaining a typical shredded paper/MWS analysis, and bottom ash and fly ash analyses from the paper plant.

The design specifications for the waste heat boiler and flue gas cleaning systems has not yet been determined. However, this will be done once the detailed fuel type, quantity and quality is finalized. This information will be used to prepare the detailed mass and energy balance for the plant.

REFERENCES

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APPENDIX A – JASPER MASS AND ENERGY BALANCE

(Later)

Allentown
City without limits.

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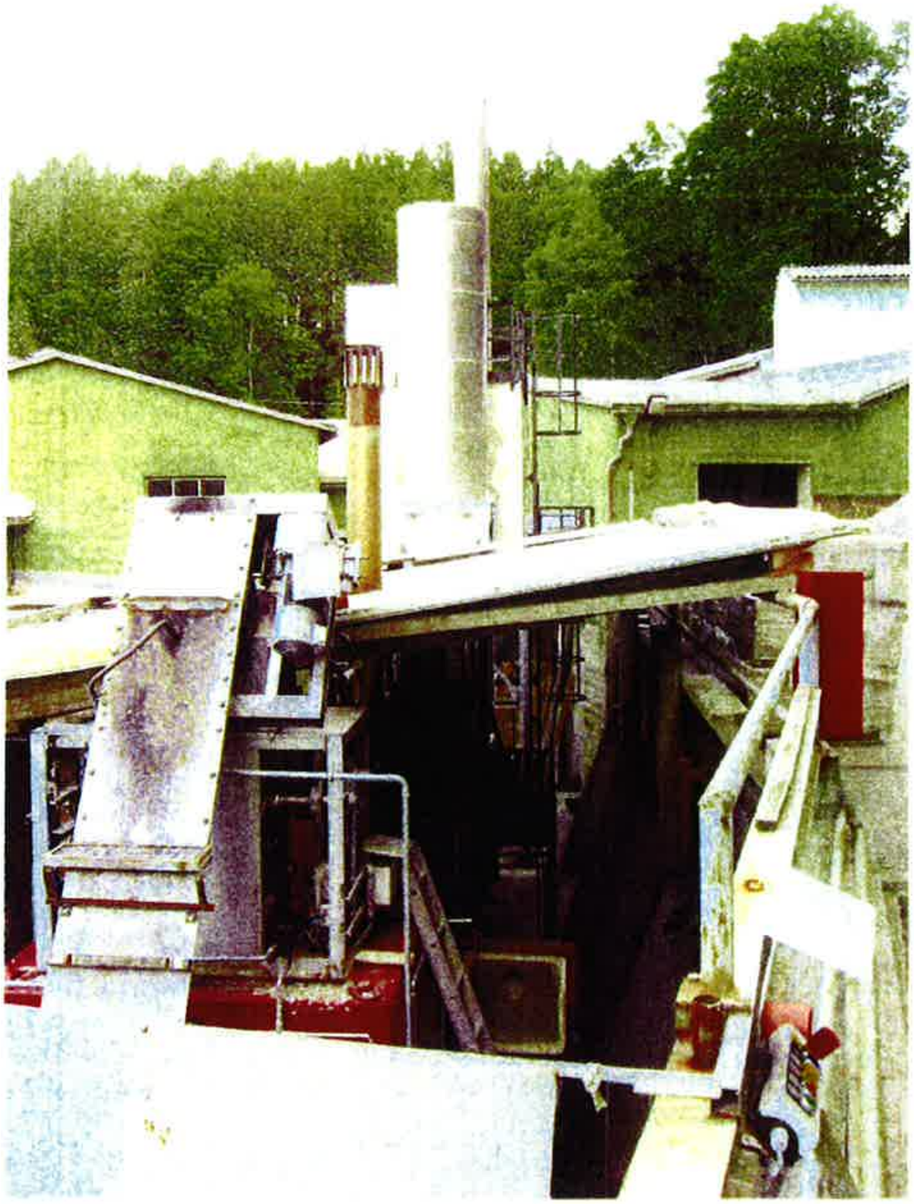
Picture 1 – South view of the Reinsberger Spezialpaper GmbH Plant
The green fiel dumpster & CCC unit are to the right – 7/14/10

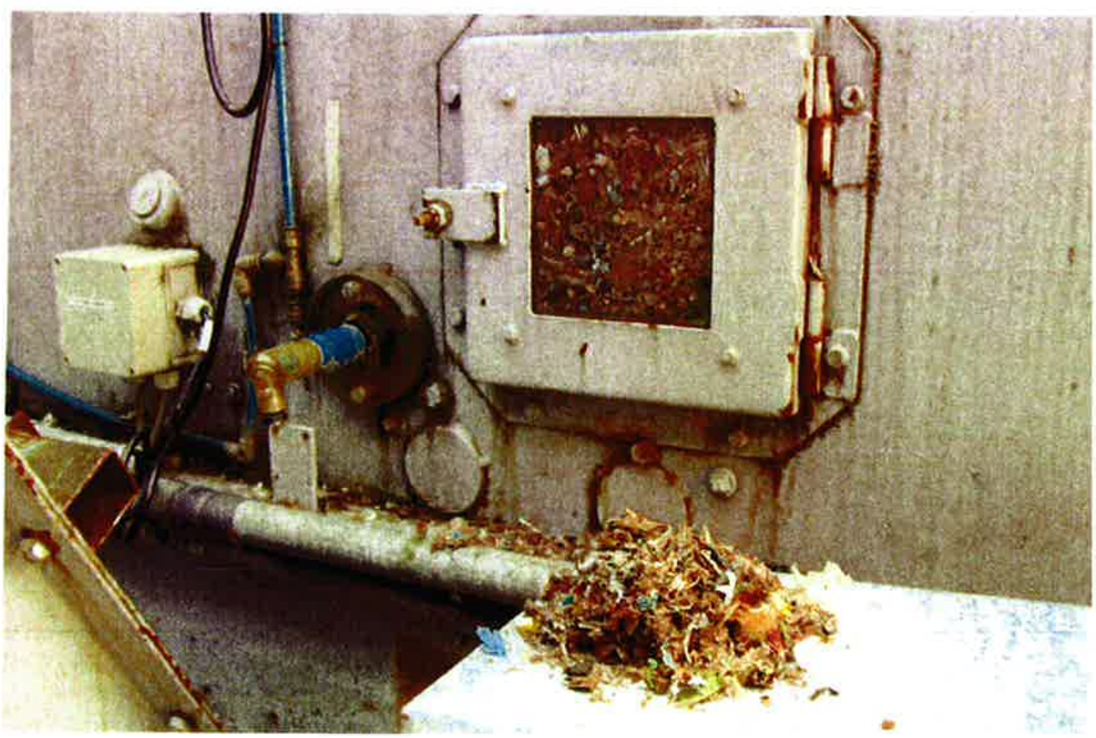
Picture 2 – Side view of the CCC unit – 7/14/10
Note: The elaborate roof & roof supports



Picture 3 – Top view of CCC unit from adjoining retaining wall – 7/14/10
Note: the Emergency gas stack on top of the main chamber & the
Open side door to the Primary chamber

Picture 4 – Top view of shredded MSW fuel within dumpster
With retractable sliding roof in open position – 7/14/10

Picture 5 – View of side access door with window on dumpster & sample
of shredded MSW fuel material in foreground - 7/14/10



Picture 6 – Side view of steam boiler to the rear of the CCC unit – 7/14/10

Picture 7 - View of small clear thermal plume coming out of the emission stack – 7/15/10