MATERIALS RECOVERY FACILITIES AND WASTE-TO-ENERGY PLANTS DO THEY GO TOGETHER?

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ABSTRACT:

Polk County, located in Northwest Minnesota, participates in a complete regional integrated solid waste management program, which includes four (4) other adjoining Minnesota counties. In the early 1980s, Polk County made the decision to utilize a waste combustor for their solid waste management to comply with the State's mandate for landfill abatement.

In August of 1988, the waste-to-energy (WTE) plant began processing municipal solid waste (MSW) and has operated without major incident since startup, and within permitted limitations. The facility has processed over 350,000 tons of MSW and collected in excess of $3.0 million dollars in steam revenues.

All five Counties have aggressive recycling programs. Despite the implementation of these collection programs, numerous recyclables and objectionable/problem items remained in the waste stream being delivered to the plant. These materials resulted in considerable system damage causing ever-increasing maintenance and downtime costs. Most of these contribute nothing to the energy recovery aspect of the system and eventually end up in the landfill incurring hauling costs and consuming expensive space in the monofill ash cells.

In addition, the quantity of MSW delivered to the incinerator had steadily increased to the extent that during peak seasons the plants burning capacity was exceeded even with recycling programs in place. This required bypassing MSW to the landfill, which is contrary to the original intent of the resource recovery plant.

Accordingly a project team was assigned to evaluate various ways to approach these problems. The team recommended the development of a facility to preprocess all incoming MSW to provide the answer. The system could have the potential to offer additional benefits as well.

This paper outlines the steps taken and the eventual results from incorporating a Materials Recovery Facility in front of the Waste-to-Energy plant. The paper will detail the complete decision making process from inception through construction, startup and daily operation. Also included is data that will show the positive and negative impact this facility has had on the overall system.

INTRODUCTION:

Initially the Waste-to-Energy plant operated as expected with only minor operational changes being incorporated. This facility operates two 40 ton per day mass burn starved air type waste combustors. The units were manufactured by the John Zink Company and are similar in design to a Consumat Unit. Hydraulic powered ash plows are used to move the material through the primary chamber across water-cooled hearths. The hearths are stair stepped and ash eventually exits the unit into a wet sump.

Heat recovery boilers are used to produce energy in the form of steam and electrostatic precipitators are the air pollution control devices. Both systems are completely independent of each other sharing only a common vent stack.

CONCERNING EVENTS:

In the early to mid 1990's several things began to happen. The volume of incoming MSW was increasing to the extent that during peak summer periods the WTE plant's capacity was exceeded resulting in material being bypassed to the landfill. This was not predicted to occur for some time as it was felt that improvements in the counties' recycling rates would offset MSW tonnage increases. County recycling was increasing but at a snails pace. In addition maintenance costs were rising annually at an abnormal rate, and plant downtime due to breakdowns was increasing. Pending air emission rules both from the Environmental Protection Agency and Minnesota Pollution Control Agency were a major concern.

A project team was established to determine how to approach the problems of increased bypass to the landfill, rising maintenance costs, and excessive plant downtime. It became obvious that the primary culprit was large problem and objectionable items such as bicycles, small appliances, auto parts, and lawn mowers. Polk has published and tried to enforce an unacceptable items list for the Counties to follow but its success has been marginal. Haulers cannot see everything in the dumpsters and cannot be expected to sort through the trash fearing exposure to who knows what. Residents and businesses became very clever in their efforts to hide or disguise objects.

People prefer to receive a full service for a fee. They have trash to get rid of and they want it all to disappear. After all before the WTE plant and recycling they just left everything on the curb in the morning and it was gone when they returned at night.

PROBLEM SOLVING:

Realizing that problem/objectionable items would always continue to come into the plant, the project team looked at options to remove these before incineration. The tip floor was too small to have employees try to remove these items, and there was the issue of safety with the loader operations, incoming deliveries, and exposure to potentially dangerous materials.

The team soon determined that removing just the large problem/objectionable items would only be a partial cure. Many recyclable items still remaining in the waste stream also contributed to system damage and high maintenance costs. These were identified primarily as glass, ferrous products, and aluminum items. There are others besides these. We recognized that some people are simply opposed to recycling.

CAPITAL ASSISTANCE PROGRAM:

The State of Minnesota has invested substantial dollars into environmentally preferred projects that promote the State's hierarchy for solid waste management. The mechanism used is the Capital Assistance Program that is funded by the State legislature and is available only to Government entities. This program is managed by the Office of Environmental Assistance and has been successful with most applications. It should be noted that no funding is available for landfill construction.

The CAP funded several MSW compost systems throughout the state. These systems processed MSW by removing recyclable items, making fuel pellets or RDF for waste combustors, and attempting to convert the residue into a usable compost material. However these facilities were extremely expensive and have had limited success. Various members of the project team visited several of these facilities to evaluate the process and look at the potential for solving our needs. These visits disclosed that some of the equipment utilized in their process could possibly solve some of our problems if applied properly. We did not need to make compost or fuel pellets just remove the various troublesome components.

WASTE SORTS:

Waste composition sorts are an absolute necessity when considering a system of this magnitude, and one of the first steps to be taken. Polk County has conducted eight waste sorts many of which contained data on the items targeted to be removed in a MRF. This information is an absolute necessity for system design criteria, material handling, storage, marketing, shipping and overall financial feasibility.

GOALS AND OBJECTIVES:

A list of goals and objectives was established along with a potential solution for each based on site visits and other vendor information. Visits to existing facilities were made from the east to the west coast. While the purpose of many of these projects usually went far beyond our scope, the help and advice received by the operators proved to be a valuable asset in the final design and equipment selection process. It was decided it would be better not to attempt to re-invent the wheel if proven technology and design already existed. The team then developed the following:

Goals/Objectives	Possible Solutions
• Remove Non-Burnable/Objectionable Items	Pick station to remove batteries, small appliances, metal pieces, rocks, etc.
• Supplement Curbside Recycling	Manual and mechanical separation to remove recyclables such as corrugated, paper, glass, aluminum, ferrous, etc.
• Maintain Steam Production	Higher average BTU content of the processed material.
• Increase Overall Plant Throughput	Pick station to remove items with BTU content such as plastic, newsprint, and corrugated.
• Reduce Ash Hauling	Mechanical separation of glass and scrap iron as well as removal of other problem/objectionable materials.
• Employee Safety	Trommel for bag opening, and magnetic separation for removal of ferrous and aluminum materials.
• Improve Air Emissions	Trommel to remove small materials containing heavy metals.
• Profitability	Sales of recyclables and reduced WTE plant maintenance costs could possibly justify the added O & M costs.

GRANT REQUEST:

A conceptual design was developed and preliminary and final grant applications were submitted to the OEA requesting approval of a CAP Grant to provide funding assistance for the project. Support from all of the Counties through resolutions, waste supply documentation, technical feasibility, project estimates, timelines, and financial projections were included in these submittals.

Before finalizing the financial analysis and grant application, an RFP was issued to determine equipment cost estimates for a conceptual design. Other design alternatives would also be considered. The RFP requested building size, manpower requirements, supportive equipment, and projected annual O & M costs. The project team evaluated markets and determined they were available and competitive although distance was a concern from our location. The markets were found to vary substantially prompting a very conservative approach to revenue projections. Steam sales were considered to remain consistent since production was calculated to be unaffected since mainly non-burnable (no or low BTU) materials were being removed.

The project team elected not to stick its neck out too far so assumptions for the financial analysis considered removing about half of the aluminum, ferrous, and corrugated materials as appeared available from the waste sorts, and then used very conservative market values to calculate annual revenues. The financial analysis projections used conservative revenues from the sales of recyclables, historical steam sales, added O & M costs for the MRF, reduced O&M for the WTE facility, and new debt service. The analysis indicated a break even thereby having no negative impact on the tip fee.

Armed with all of this, Polk County made a presentation to the Solid Waste Management Advisory Board (a citizens group appointed to review and recommend projects for Grant funding) to obtain a recommendation for the OEA to award a Grant to Polk County for this project. After the presentation was given, the recommendation was made and a Grant was eventually awarded. This was a major step since the Grant monies would fund almost half of the capital costs for the project.

GREEN LIGHT:

At that point, Polk had the green light to move forward with the MRF. A modified RFQ was issued which contained a recommended layout and equipment description. Included in the RFQ was processing capacity, operating schedule, and guaranteed removal efficiencies for various components. Also requested in the RFQ was the building configuration to contain the processing equipment proposed. After evaluation of responses to the RFQ, an equipment supplier was selected. The building design was contracted and the project team obtained bids for the site work, the building addition, mechanical and electrical requirements, and office and employee facilities.

Since the project team had sufficient knowledge and expertise in the area of project management, Polk County elected to act as the General Contractor for all of the project work. Local bids were obtained for the building foundation, floor, lighting and electrical service, mechanical piping including a sprinkler system, office and employee facilities, and air handling equipment. Although some risk is involved with this approach, substantial cost savings were realized. Building construction went as planned and the entire project was completed in a little over twelve months from vendor selection to startup.

SYSTEM PROCESS:

Basically the MRF consists of a feed hopper and in-feed conveyor leading to an initial pick station where hand removal of large objectionable/problem items and clean corrugated material takes place. A conveyor and baler are positioned below the pick station to continuously bale the corrugated material. This baler is also used to bale accumulated aluminum and ferrous products during slow or off- peak times.

A trommel follows acting as a bag opener, and for screening out the small and mid-size fractions of the waste stream. The small fraction, called fines, consists of food scraps, dirt, glass, and many other low BTU content materials under 3" in diameter. The fines are disposed of in a lined MSW cell in the Polk County landfill and make excellent fill for cracks and voids created by large items such as furniture.

The mid-size materials, under 7" in diameter, are also screened out in the trommel. This waste stream is conveyed through magnetic separation to remove ferrous items, passes over an eddy current system which removes the aluminum, and is then combined with the over-size stream which exits the end of the trommel. The over-size stream also passes through magnetic separation for ferrous removal. Magnetic and eddy current separation have proven to be much more efficient than manual removal and the added costs are financially justified. This also minimizes employee requirements, and risk of exposure to hazardous materials.

The combined mid-size and over-size waste streams pass through a final pick station before being conveyed to the tipping floor for processing in the waste combustors. The final pick station platform is designed to capture materials that escape the initial pick and the mechanical separation process. It also has the capability to focus on the removal of other recyclables that are exposed after passing through the trommel. This waste stream that is delivered to the tip floor consists largely of high BTU paper and plastic products.

THE REST OF THE STORY:

Now (as Paul Harvey says) for the rest of the story. The system has performed as good if not better than expected. Employee training was critical in the recognition and handling of hazardous materials, types of recyclable corrugated to remove, and other burnable and non-burnable materials to extract during the initial pick. Bale tying and forklift training were also important as well as bale handling, stacking, and load-out procedures.

A representative from the selected market for the corrugated material arranged a visit to their plant for the MRF employees to familiarize them with their processing operations and the type and quality of material that can be accepted. After startup the corrugated buyer visited the MRF to confirm what materials and quality were being selected. Since that time the buyer has been most pleased with the amount and quality of material shipped.

The learning process for the initial pick station soon indicated that many items other than corrugated and non-burnable should be removed at that point and delivered directly to the WTE plant. Some of these are baler twine, long pieces of film plastic, rope, etc that caused operational problems passing thru the MRF. If anything this initial pick platform could be expanded to remove other recyclable and problem items.

The trommel has operated successfully meeting bag opening and sizing functions almost as expected. Bag opening efficiency ranges above 85 percent meaning that some unopened bags pass through the system. These are usually very light containing mostly burnable materials. There are some unburnable materials that remain in the unopened bags that end up being processed through the WTE plant, and eventually are disposed of in the landfill. So far these have not presented near the operational problems that existed when burning unprocessed MSW.

Design changes to the trommel teeth have improved the bag opening efficiency, and the trommel hole size selected for the small component (fines) was determined to be too large resulting in lost aluminum recyclables and fines tonnages greater than projected. However stack tests showed significant reduction in heavy metals emissions one of which, mercury, is a controlled substance. Reducing the hole size might jeopardize this positive result, but would definitely reduce the amount of fines generated and lost aluminum recyclables. The decision was made to reduce the opening by covering up half of the three-inch diameter hole. Records will show that the fines tonnage was reduced by almost half and the heavy metals emission rates were virtually unaffected.

Magnetic separation is effective in removing almost all ferrous materials. However, many contaminants are also removed in the process requiring manual removal to satisfy market requirements. Attempts to improve this have had minimal results. Recently another baler was purchased and set up with conveyors positioned under the magnets to accumulate and convey the ferrous products to the baler. A pick station is utilized to remove the contaminants.

Eddy current separation for removal of aluminum is excellent. It is estimated that almost ninety percent of all aluminum is removed in this station. This is important because aluminum is a very attractive financial market that produces high revenues. The aluminum market expects minimal contamination and therefore the material is also hand picked prior to baling.

The final pick station platform is designed to capture materials that escape the initial pick and the mechanical separation process. It also has the capability to focus on the removal of other recyclables such as plastic, which is exposed after passing through the trommel. The plastic market has been unattractive since startup, and Polk chooses to burn this high BTU material for steam production and sales. If the plastic market did develop and MSW tonnages continue to increase, the MRF has the capability to remove this material for revenues while maintaining plant throughput. The final pick is only used periodically and to date cannot justify an added employee.

Based on the goals and objectives that were set for the system, the results are conclusive:

Goals/Objectives	**Results**
• Remove Non-Burnable/Objectionable	Non-burnables are almost entirely removed.
• Supplement Curbside Recycling	Increased all five counties recycling rates by thirty to fifty percent.
• Maintain Steam Production	Steam generation has not been affected.
• Increase Plant Throughput	Plant throughput increased from 600 tons per week to 750 tons per week.
• Reduce Ash Hauling	Ash generation and hauling have been reduced by more than fifty percent. Hauling and disposal of the fines component offset this savings.
• Employee Safety	The use of the trommel for bag opening and magnetic and eddy current separation for removal of ferrous and aluminum materials has proven successful.
• Improve Air Emissions	Heavy metals emissions have been reduced to below the proposed EPA limits.
• Profitability	The facility has proven to be self-supporting over the first three years of operation.

CONCLUSION:

If you believe in resource recovery and operate or are planning a WTE facility, a MRF will optimize the overall performance of the facility as well as extend its operating life for many years. Yes, it is this author's opinion that "materials recovery facilities and waste-to-energy plants do go together".

RECOMMENDATIONS:

We recognize that all WTE plants are usually unique in their design and purpose, and what works for Polk County may not work at another location. However, Polk is enjoying so many benefits from this system, many of which have not been mentioned in this paper, that it would encourage other municipal solid waste combustor owners/operators to at least conduct a feasibility study for incorporating a Materials Recovery Facility into their system.