HIGH THROUGHPUT VITRIFICATION FOR DOE WASTE REMEDIATION

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ABSTRACT

Vortec is engaged in two contracts involving the vitrification of DOE low-level radioactive wastes. When operationally implemented, the resulting plants will enhance the DOE ability to achieve their year 2006 clean up. The DOE Technology Development contract, administered through the Federal Energy Technology Center, is for construction and demonstration of a vitrification plant to demonstrate the operational scale remediation of low-level, mixed, and TSCA/mixed waste soils. Success with this major technology deployment program can provide a method that can treat a broad range of solid wastes across the DOE complex.

Vortec also has a contract with Fluor Daniel Fernald (FDF) to conduct a Proof-of-Principle Test using a simulant of the Fernald Silo 1 and Silo 2 wastes. Concurrently, preliminary system concepts and designs are being synthesized for an operational plant. Success with this test and continuation to the next phase of implementation will provide a method that can treat a broad range of mixed and TSCA/mixed sludge wastes.

The principal objectives of these programs are to demonstrate the ability of a Vortec Cyclone Melting System (CMS™) to remediate DOE contaminated wastes that are low-level, mixed and mixed wastes with TSCA components. These programs will verify the ability of this vitrification process to produce a chemically stable glass final waste form, which passes the TCLP quality control requirements economically.

While the FDF program will demonstrate the CMS™ capability with a simulant of contaminated sludge that contains low-level, and mixed wastes, the FETC program will demonstrate using actual waste from the DOE Paducah site.

The basic components of the CMS™ are a counter-rotating vortex (CRV) reactor, a cyclone melter (CM), and a glass product reservoir. The balance of the plant for either vitrification system consists of feed preparation, blending, product handling, heat recovery, air pollution control, waste water treatment and utility systems.

Both systems are designed to process 1,360 kg/hr (1.5 tons/hour) of as-received wastes. These high throughput units will provide increased confidence that DOE can achieve their goal to clean-up wastes by the year 2006.

Conclusions are presented, which will aid other DOE system integrators in transitioning innovative technologies to operating systems. Information will also be provided illustrating the CMS™ ability to vitrify.

INTRODUCTION

The Department of Energy has established a goal to clean up its nuclear complex by the year 2006. This will require the deployment of high throughput technologies to treat the wastes. The technologies must be able to treat a broad range of waste varying in both contaminants and in physical form in a timely and economical manner. They must also be able to accomplish this task with minimum public and occupational health risks, and minimum environmental risks. Additionally, the technologies must transform the waste into a final form, which has long-term stability to prevent migration of contaminants. It is imperative that the technology not present any major obstacles to its own safe decontamination and decommissioning. Finally, the final waste form produced must be very stable since some of the radioactive materials have very long half-lives that greatly exceed the capability of institutional controls to protect the environment.

The Department of Energy and its contractors have been evaluating the development of various innovative technologies. Vitrification and other thermal treatment technologies are being extensively evaluated because of their ability to process a wide variety of organic, heavy metal, and radionuclide contaminated wastes. The Vortec Cyclone Melting System (CMS™) vitrification process has the advantage of being very robust with regard to the wastes that can be effectively processed and the spectrum of final glass compositions that can be produced.

Wastes that have the potential of being processed using the Vortec CMS™ technology are classified as low-level, mixed, and TSCA/mixed. They can be either soils, as in the case of DOE Paducah waste, or sludges which are found in Silos 1 and 2 at DOE Fernald. Additionally, the CMS™ can also process liquids such as the Hanford tank wastes. The wastes can be processed by the Vortec CMS™ less expensively than the cost of the alternatives being considered by DOE (1, 2). Studies are underway by Vortec to refine operating costs for processing the Fernald wastes. They are expected to be in the same range as the Paducah Plant costs because of the comparable costs of the similar equipment, which they each use.

The principal reason for this reduced cost is related to the CMS™ high throughput and ability to handle a wide variety of waste streams in various physical forms.

Progress is being made in the implementation of a demonstration of the CMS™ at the Paducah Gaseous Diffusion Plant (PGDP). Successful implementation of the CMS™ technology will significantly increase the rate at which LLW, MLLW, and TSCA/mixed waste soils can be processed. This increased rate will translate into reduced clean up costs to DOE.

Progress has also been made in the Proof-of-Principle Tests conducted for FDF. Vortec has successfully completed a 72-hour, continuous vitrification proof-of-principle test. During this test, approximately 20,000 pounds of the demonstration slurry (30% solids and 70% water) was vitrified with the Vortec vitrification unit.

The test was conducted at Vortec's operational pilot facility at the University of Pittsburgh Advanced Research Center (U-PARC). Vortec's system has demonstrated the production of glass and the vitrification of a variety of feedstocks, including:

1. EPA surrogate soils
2. DOE surrogate soils
3. Spent pot liners (K-088) wastes
4. Coal fired boiler ash
5. Sewage sludge ash
6. Auto shredder residue ash
7. Municipal solid waste incinerator ash
8. Metal plating sludge
9. Fiberglass waste with organic contaminants
10. Dusts containing heavy metals and organic materials
11. Electronic industry wastes
12. High sodium content tank waste surrogate

THE VORTEC PROCESS DESCRIPTION

The primary components of the basic CMS™ are a counter-rotating vortex (CRV) reactor and a cyclone melter. A sketch of the basic CMS™ concept is shown in Figure 1. A unique feature of the process is the rapid suspension heating and oxidation of feedstock materials in the CRV reactor prior to the physical and chemical melting processes, which occur within the cyclone melter.

The use of the Vortec CRV reactor in conjunction with a cyclone melter distinguishes the Vortec cyclone melting technology from other types of cyclone systems. In the CMS™ process, the feedstock (prepared waste and granular glass-forming ingredients) are introduced into the top region of the CRV reactor. The heated gases (above 2,000° F) are introduced to the CRV through the inlet arms. Therefore, at no time does the waste come into contact with the fuel. As a result of the intense counter-rotating vortex mixing, it is possible to achieve a stable reaction zone in the presence of large quantities of inert particulate matter (solids-to-gas mass ratios on the order of 1:1). Both convection and radiation heat transfer mechanisms contribute to the rapid heating of the feedstock materials within the CRV reactor. Any organic contaminants in the feedstock are also effectively oxidized.

The melted material formed in the cyclone melter and the reaction products exit the melter through a tangential channel and enter a separator-reservoir (not shown in the figure) where a pool of molten material exits the reservoir through a bottom or side tap. The flue gases exhaust to a heat recovery unit, for reaction air preheating. The flue gas exiting the heat recovery unit is treated in an air pollution control system prior to being exhausted out the stack. As a result of the high thermal efficiency of the Vortec CMS™, the flue gas flow rates are relatively modest. Because the temperature and composition of the vitrified product can be closely controlled, the amount of process fuming (volatile carryover) can also be minimized.

The average gas-solids suspension temperature leaving the CRV reactor is typically on the order of 2,000°F to 2,700°F and is a function of the product being vitrified. The process temperatures in the cyclone melter are typically in the range of 2,000°F to 3,000°F, depending on the melting characteristics of the feedstock being processed. The nitrogen oxide emissions have been found to be substantially lower than those which occur in conventional cyclone reactors. Excess air levels are typically in the range of 5% to 20% depending on the makeup and the nature of the feedstock being processed.

Heat rates demonstrated by the Vortec pilot scale facility typically ranged between 3.0 and 6 million Btu/ton at a glass production rate of 15 TPD. This heat rate is 50% to 80% lower than heat rates for conventional gas-fired glass melting at a similar capacity. The energy savings are primarily due to more efficient heating of the glass ingredients in suspension and lower structural heat losses due to the small physical size of the process components. The CMS™ can also accommodate the use of a variety of fuels, such as oil and coal-derived fuels, and even organic waste materials. The CMS™ pilot system has demonstrated NO_X emissions of less than 4 pounds per ton of vitrified product, meeting the California emission standard for glass melters, currently the most stringent in the United States. The CMS™ demonstration plant is designated as a glass melter by the State of Kentucky. With natural gas as the primary fuel, the NO_X emissions, calculated as NO_2, have typically been approximately 2 pounds per ton of product. Rapid temperature quenching of the offgas products by the inert solid particles and staged reaction are the primary means of limiting NO_X emissions. Tests conducted for Hanford using a high nitrate concentration tank simulant resulted in no visible plume leaving the pilot plant’s stack.

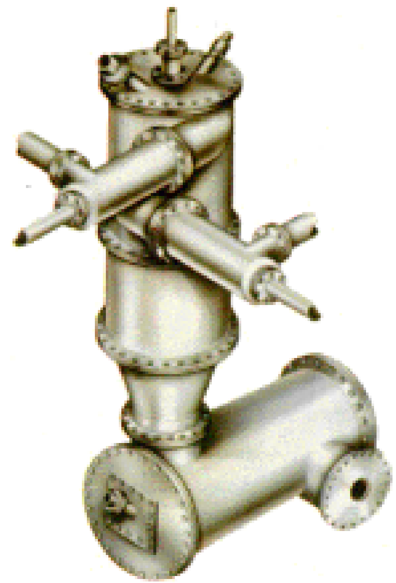

Figure 1 Vortec Cyclone Melting System (CMS™)

Technology Comparisons

The data presented in Table I is a qualitative comparison of alternate remediation technologies for DOE applications. The comparisons presented are for landfill, incineration, stabilization, and vitrification alternatives. From the comparisons presented in Table I, vitrification technology is judged to be superior with regard to its ability to produce a vitrified product (final waste form) which has the highest level of chemical stability and its ability to contain inorganic contaminates. In addition, vitrification processes also effectively destroy organic compounds because of the high operating temperatures and residence times at these temperatures.

Table II presents a comparison of different classes of vitrification technologies. The data indicates that major advantages of the CMS™ technology are its low operating/maintenance cost, its high throughput capacity, and its operational robustness while being able to produce a product which meets or exceeds all of the applicable product quality control and leaching criteria. The CMS™ has been demonstrated not to be as sensitive to variations in the waste stream's chemical composition as other vitrification processes.

Benefits

Vortec has been working with DOE in developing the CMS™ to remediate various waste streams of concern to DOE as part of the innovative technology effort. The demonstration plant at PGDP will demonstrate the cost and operational effectiveness of the CMS™ process.

The unique features of the CMS™ technology make it a particularly cost-effective process for the vitrification of soils, sediments, sludge, and other solid wastes containing organic, metallic, and/or radioactive contaminants. Many of the benefits of the CMS™ technology recognized by the glass and hazardous waste management industry also apply to DOE's ER&WM needs. Benefits with respect to DOE's needs are:

Table I Comparison with Alternate Technologies

Alternatives	Advantages	Disadvantages
Landfilling	Low initial capital investment	No waste volume reduction Does not destroy organic compounds Does not stabilize metals & radionuclides Requires long term monitoring Has significant potential for ground water contamination Does not diminish generator long term liability Low potential for resource recovery
Incineration	Reduces waste volume Destroys organic compounds	Preferred application is high organic content wastes Generates substantial residuals Residuals have leaching problems Requires air pollution control Hostile regulatory environment
Vitrification	Reduces waste volume Destroys organic compounds Stabilizes inorganic contaminants Products consistently pass TCLP and PCT Long term product stability Minimal long term generator liability Reduced life cycle cost	Will require landfill of vitrified product only if radioactive (otherwise a value added product can be generated) Requires some waste separation or pretreatment Requires air pollution control
Stabilization	Reduces landfill liability Low initial capital cost	Significantly increases waste volume No guarantee of effectiveness Requires landfill monitoring No reduced long-term generator liability No significant life cycle cost advantage

Table II Comparison with Other Vitrification Technologies

Alternatives	Advantages	Disadvantages
Joule Heating	Destroys organics Stabilizes inorganics	Expensive (cost of electrical power and maintenance) Low throughput capacity Potential volume increase Effectiveness limited by metals contamination, moisture, and carbon/organic content Phase separation is common Accelerated refractory wear Requires air pollution control Requires waste preparation Organics may require additional processing
CMS™ Technology	Very high throughput capacity Destroys organics Stabilizes inorganic contaminants Organics contribute to energy source Effective treatment of solids, liquids and gases Multi-fuel capability Produces a homogeneous product without phase separation Low operating and maintenance cost	Requires waste preparation Requires air pollution control
Molten Metal Processes	Stabilizes waste Provides volume reduction Can process organics and metals	Very expensive Very little operational data available High maintenance and refractory wear Phase separation inhomogeneous products Requires air pollution control Requires waste preparation Requires post oxidation or after burning High metals carryover
Plasma and Electric Arc Processes	Provides volume reduction Can treat solids, liquids, or gases	High operating and maintenance costs Low throughput capacity Produces inhomogeneous products Product leaching problems Incomplete destruction of organics Requires air pollution control Requires post oxidation or after burning Inefficient energy utilization Limited applicability High volatilization of metals, inorganics

1. The ability of the CMS™ to produce a product which provides for long-term immobilization of heavy metals, toxic inorganics, and radionuclides. In numerous pilot scale tests conducted by Vortec, the CMS™ has demonstrated the ability to effectively process RCRA wastes as well as surrogate contaminated soils. Simulated radionuclides and RCRA metals are effectively retained in the glass product and do not leach when tested using both the PCT and TCLP.

2. The CMS™ has demonstrated the ability to effectively oxidize and destroy organic contaminants. Tests performed by Vortec with various carbonaceous materials such as cyanides and other organic contaminants found in most industrial waste, and anthracene and 1, 2-dichlorobenzene as surrogates for organic and PCB contaminates, have validated the organic destruction performance of the CMS™.

3. The CMS™ has demonstrated substantial flexibility with respect to the processing of various types of solid wastes and can accommodate substantial variations of feedstock composition. Vortec has completed more than 150 test programs using a variety of materials as feedstocks including U.S. Environmental Protection Agency (EPA) contaminated soils, flyash, baghouse dust, metal plating sludge, aluminum industry waste, steel industry waste and virgin glass making components. Soils with water content of up to 50 weight percent have been processed into glass products.

4. The CMS™ demonstrated the ability to oxidize and vitrify waste materials introduced as slurries, providing the capability for mixing contaminated or waste oils with various types of hazardous solids, soil wash process sediments, and mill tailings. In addition to contaminated soils, Vortec has demonstrated the ability to vitrify Hanford low-level tank waste surrogates with a water content of approximately 60% liquid and 40% solids. The CMS™ has also demonstrated the ability to effectively vitrify a spectrum of metal plating sludge at 60% water content.

5. The CMS™ high temperature process components have water-cooled, steel walls providing for a sealed process which can be operated at negative pressure to prevent leakage of contaminated gases to the atmosphere. These water-cooled components can continue to operate in the event that unusual wear or spalling of refractory occurs until such time as the unit can be safely shut down.

6. The 36 TPD CMS™ Paducah demonstration unit is being designed to be transportable and modular which can enable wastes at other sites to be processed.

7. In the processing of substantial quantities of contaminated soils, the life cycle cost of the Vortec CMS™ is lower than other existing vitrification processes and disposal methods. The CMS™ can be used at a cost of $650-1,340 per ton (volume dependent). Table III provides a cost comparison of the CMS™ with other methods.

Table III Cost Comparison - Treatment and Disposal (per ton)†

CMS™	$650-1,340*
Broad Spectrum	$9,900
Joule Heated Vitrification	$10,780
Stabilization	$18,000

† Source: "Waste Treatment Cost Study", Systematic Management Services, Sept. 1998
* Volume dependent

PRESENT DEVELOPMENT

DOE Paducah Solid Waste Soils Program

The principal objectives of the DOE FETC/Vortec program is to:

1. Demonstrate the ability of the Vortec CMS™ to remediate contaminated, mixed low-level waste and other waste forms of interest to DOE by operating the CMS™.

2. Produce glass, which passes TCLP and PCT. The system has a nominal design capacity of 1,360 kg/hr [1.5 tons per hour (TPH)] with the capability for expansion to 2,730 kg./hr (3 TPH) by adding oxygen enrichment. The wastes consist of 30% moisture.

Additional objectives will be met during the program, such as:

1. Establish the glass chemistry requirements to achieve effective vitrification of contaminated waste found at the Paducah site; that is given a particular waste, determine how its oxide composition must be modified to produce a vitrified product that will immobilize contaminants over the long-term.

2. Establish waste size reduction, moisture content, and the glass fluxing requirements.

3. Establish the cost of construction and operation of the CMS™ system.

4. Determine the Destruction Removal Efficiency (DRE) of the CMS™ for organic contaminants likely to be found in waste from DOE sites requiring remediation.

5. Verify the character of the off-gas and the effectiveness of the flue gas clean-up system at meeting the Air Permit requirement.

Phase 1 consisted of pilot scale testing with Vortec's pilot plant with surrogate wastes (as done for the FDF program) and the conceptual design of a process plant for a generic DOE waste stream. During Phase 2, a PGDP conceptual design was developed for the processing of LLW soils and mud containing TSCA organics and RCRA metal contaminants. Phase 3 includes the construction and operation of full-scale demonstration at DOE Paducah.

The system design developed for Paducah has significantly enhanced the processing capabilities of the Vortec vitrification process. The overall system design now includes the capability to shred entire drums and drum packs containing mud, concrete, plastics, and PCB's. This enhanced processing capability substantially expands the total DOE waste remediation applications of the technology.

Vitrification trials were conducted at Vortec's pilot scale vitrification plant. The sampling of the effluent and influent streams taken during the tests confirmed that virtually all of the radionuclides were retained in the glass and would not leach to the environment. This was confirmed by both Product Consistency Tests (PCT) and Toxicity Characteristic Leaching Procedure (TCLP) testing. The organic contaminant was destroyed during testing with a Destruction Removal Efficiency (DRE) of at least 99.99%, and semi-volatile RCRA metal surrogates were captured by the Air Pollution Control System (APCS). The data generated during these pilot tests relating to the partitioning of the contaminants throughout the system helped establish the demonstration plant's design criteria so that the Paducah Plant design will meet a DRE of 99.9999%.

There are three phases planned for RD&D testing. They are:

Phase 1 - Testing with low-level radioactive waste followed by testing with mixed waste. (This is the testing planned under the existing DOE-FETC Contract.)

Phase 2 - After obtaining a TSCA permit (and any modifications to the other permits, if required) the testing will include mixed waste with PCB's greater than 50 ppm.

Phase 3 - Process improvements and enhancements may be made to the system to increase throughput and improve efficiency of operations. Permits will be modified, if required, to reflect the changes in the system. Testing will then be conducted on the full range of wastes representative of those in the DOE complex.

DOE Paducah Plant Description

An isometric drawing of the plant arrangement in shown in Figure 2. The demonstration plant has been designed to the maximum extent possible as a transportable and modular system. The majority of the individual skid mounted components have the capability to be transported by truck without special permits.

The system flow for the Paducah Plant is shown in Figure 3. Contaminated soil in drums from DOE-PGDP is introduced into the Feed Preparation System. Here the drying, crushing, metal and plastic separation, and particle sizing processes occur to assure that the material is "clean" and properly sized.

All the conveying systems will be designed with an enclosure and operate under negative pressure. All hoppers and transfer points (dumping points) will also be enclosed and will be under negative pressure. The dust laden air from these devices will pass through a dust collector for particle removal. Solids collected in the dust collector will be transported back into the system. Discharge from the dust collector will pass through a parallel pass HEPA filter system.

The blending system consists of storage silos and a pneumatic feed system for the delivery of the soil and additives to a blend tank. The sized and dried waste is transported to a storage silo. Glass making additives are mixed with the soil. Additives (limestone and soda ash) are used to aid in glass forming, obtaining the proper glass properties, or modifying the temperature-viscosity curve. Batch mixing precedes feeding into the Cyclone Melting System.

The vitrification system consists of a Counter Rotating Vortex reactor, a Cyclone Melter, a separator/reservoir, and a recuperator heat recovery unit.

The prepared feedstock is introduced into the CRV reactor through injectors located at the top of the reactor. Reaction air, which has been heated by waste heat in the recuperator is mixed with propane fuel in the inlet arms of the reactor and raises the temperature. After the operating temperature (2,000° to 3,000° F) is reached in the CRV, the blended feedstock is introduced into the CRV through the feedstock inlets. As the feedstock flows down the CRV, it is exposed to the turbulent hot gases and is heated. It reacts in the liquid layer deposited on the walls of the CM, producing the glass. The radionuclides and heavy metals are chemically bonded into the glass. The glass product and the exhaust gases exit the CM through a tangential exit channel and enter a glass/gas separation assembly (separator/reservoir).

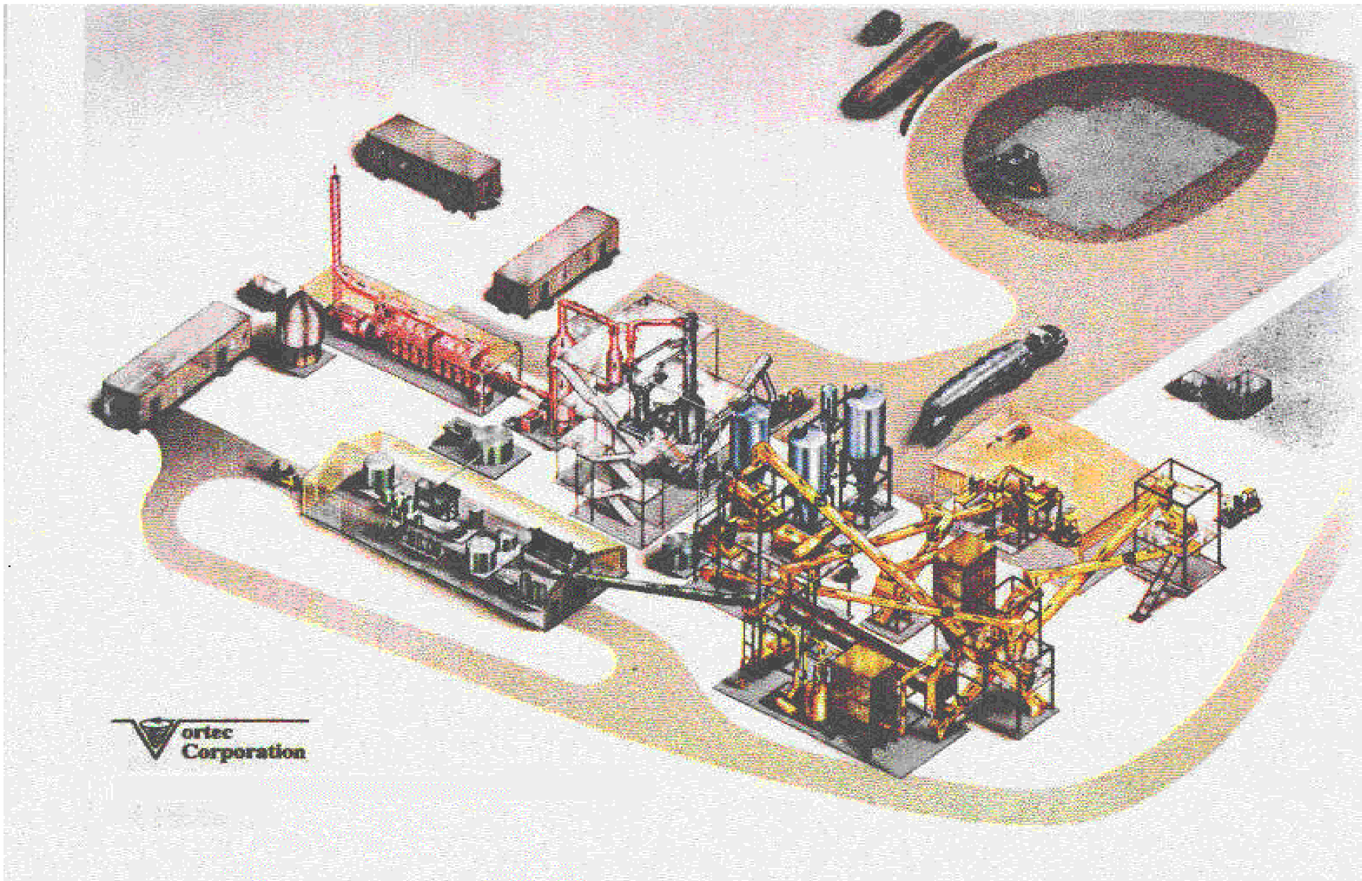

Figure 2 Plant Arrangement Sketch

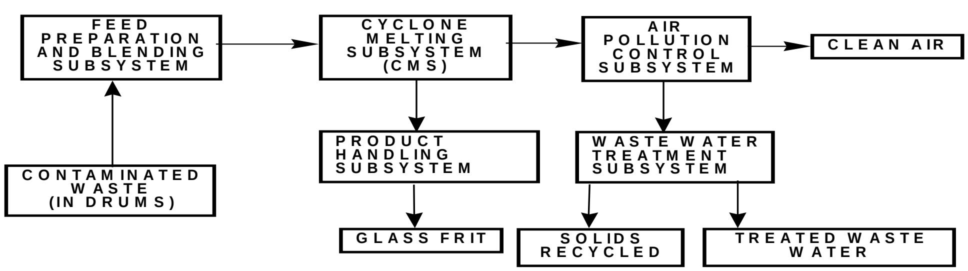

Figure 3 System Flow Diagram

The primary functions of the separator/reservoir are to separate the offgas from the melted material and to provide an interface with a vitrified product handling system. The hot exhaust products exit through an exhaust port, which is the interface for the recuperator. The recuperator utilizes the waste heat to preheat reaction air going to the CMS™. Molten glass flows out of the separator/reservoir to the Vitrified Product Handling System.

The molten product from the CMS™ will be water quenched to produce a cullet approximately 1/8" in average size. The cullet will be transported by conveyor to ST-90 boxes. The ST-90 boxes, when full, will be moved to a pick-up area for pick-up and disposal by the DOE-Paducah.

The Air Pollution Control System will consist of a venturi scrubber followed by a wet electrostatic precipitator (WESP) system. The scrubber will remove large particulate from the flue gas stream as well as serve the function of reducing the flue gas temperature to protect the APCS components. After removal of small particles in the WESP, the temperature of the off-gas is raised in an off-gas heater prior to entering the HEPA filter for removal of fine particles. Redundant HEPA filters are used to facilitate maintenance. The off-gas exits the HEPA filters and flows from the system through the exhaust stack.

The demonstration plant also includes a waste water treatment system to remove radionuclides, suspended solids, and contaminants not captured in the glass prior to testing and discharge to an outfall. Solids from the clarifier are dewatered in a filter press and are returned to the Feed Preparation System.

To demonstrate the effectiveness of the technology, 400 hours of start-up and functional testing are planned, followed by a 30-day period of testing. A decision to proceed with Phase 2 and 3 testing will be made upon evaluation of the Phase 1 test results. Any future treatment will depend upon the DOE needs, favorable test results and economic data and obtaining the necessary permits.

DOE Paducah Results

Vortec completed the verification testing and established the plant design requirements in Phase 2. Site preparation is complete. Currently, approximately 80% of the equipment has been designed and ordered with approximately 50% actually stored on site at Paducah. The State of Kentucky has judged that the CMS™ Vitrification Technology is a glass melting operation and has issued an Air Permit for the process. The draft RD&D permit is under review.

However, all regulatory issues have not been completely defined. Differences between the Air Permit and the RD&D Permit are now being resolved with the State of Kentucky.

In a related issue, DOE initiated the preparation of an Environmental Assessment (EA) as required by the NEPA process. It is expected to be completed in mid-CY 1999. In the interim, Vortec cannot assemble the demonstration plant. Equipment that is being shipped to the Paducah site can only be stored and maintained. Construction and operation must wait for completion of the EA with the result of a Finding of No Significant Impact (FONSI). A FONSI will allow construction and demonstration activities to proceed.

Vortec is awaiting the completion of the Environmental Assessment by DOE and issuance of a RD&D permit by the State of Kentucky. Pending success in both efforts, Vortec will initiate construction leading to a demonstration in the second half of CY 2000.

DOE Fernald Sludge Waste Program

In July 1993, Vortec completed a preliminary Proof-of-Principle Test for Westinghouse Hanford Corporation (WHC). 4,000 pounds of glass were manufactured using a simulant of the high sodium tank waste that contained 40% solids and 60% water. The results of that test indicated that the majority of the radionuclides reported to the glass passing the EPA's TCLP test. The Westinghouse analysis of the glass product determined that 90%-100% of the sodium and approximately 50% of the cesium, that were originally in the tank waste simulant combined into the final glass waste form.

The primary objective of the FDF program is also to demonstrate the effectiveness of the CMS™ in vitrifying similar tank waste materials being stored in Silos 1 and 2 at Fernald. The waste to be processed at Fernald is complex in nature because it is a water/solids slurry contaminated with heavy metals and low-level radionuclides. In this program, the CMS™ will process a non-radioactive surrogate into a final glass form, which will meet disposal facility requirements.

Vortec, in conjunction with Foster Wheeler, will prepare a System Requirements Document and a preliminary design of a full-scale plant. The plant will be capable of processing the entire inventory of Silo 1 and 2 residue in 36 months of operation. Foster Wheeler will be responsible for feed preparation and air pollution control systems design, Vortec will be responsible for the CMS™ portion of the plant. Foster Wheeler will also assist in reviewing the plant design to assure that it conforms to DOE, OSHA, and the State of Ohio regulations related to health, safety, and environmental emissions.

This Vortec contract will provide the necessary information to the DOE technical staff to assess the life cycle cost and effectiveness of the CMS™ process. Successful completion of the pilot demonstration at Vortec's High Temperature Test Facility can lead DOE to construct a full-scale plant at Fernald, OH to process the Silos 1 and 2 waste.

DOE Fernald Plant Concept

The DOE Fernald Plant will process 6,780 cubic meters of combined residue and Bento grout over a three year period. The plant has the same major systems as the Paducah Plant. The differences are in the equipment for each of the systems.

The feed preparation system will dewater and dry the slurry, preparing the solids for the CMS™ by milling to a mesh size less than 35. The system consists of a clarifier, dewatering screw, wet solids hopper, dryer screw, and ball mill.

The milled material is stored in the dry feed silo. It is blended with the glass additives from the additives silo for introduction into the CMS™.

The vitrification system is similar to the Paducah Plant system and the glass product is also treated similarly to that for the Paducah Plant.

The air pollution control system consists of an evaporative cooled baghouse and a condenser scrubber system. The system is designed so that the off gas will contain less than 20 PPM SO_2, NO_X, and 10% volume CO_2.

DOE Fernald Program Results

During the week of November 30, 1998, Vortec successfully completed a 72-hour, continuous vitrification proof-of-principle test. During this test, approximately 20,000 pounds of the demonstration slurry (30% solids and 70% water) was vitrified. The Vortec glass melter realized a system availability of 99.58% which far exceeded the goal of 95%. The slurry used chemically and physically represents the Fernald waste.

The test, conducted at Vortec's Vitrification Pilot Plant in Harmarville, PA, was witnessed by representatives of Fluor Daniel Fernald, Department of Energy, US EPA – Region 5, State of Ohio – EPA, and the Fernald Stakeholders Group. These witnesses were impressed with the simplicity and effectiveness of the Vortec Cyclone Melting System (CMS™) and the ease with which the Vortec test was accomplished. The reliability, waste loading, and high throughput demonstrated during the test will be factors that could ultimately lead to the selection of the Vortec Vitrification System for the remediation of the Fernald Silos 1 and 2 waste.

CONCLUSIONS

Vortec believes that the CMS™ technology is at the stage of development that will result in a mature process that is directly applicable to a large number of DOE Environmental Restoration and Waste Management (ER&WM) needs. Vortec is developing the CMS™ technology to commercial readiness, with the intention of economically meeting all of the public occupational and environmental health and safety requirements for remediation technology.

The success of the test for Fluor Daniel Fernald is of significant importance for the DOE Paducah Gaseous Diffusion Plant. This is the same vitrification technology which Vortec intents to demonstrate the capability to treat the Paducah Gaseous Diffusion Plant waste soil which is contaminated with low level radioactivity, heavy metals, and PCB's.

Pending successful completion of the environmental assessment by US DOE Paducah with a finding of no significant impact, the Vortec system will be constructed. Successful completion of the demonstration can provide an approach to clean up which will allow DOE to meet their scheduled commitment for waste treatment.

ACKNOWLEDGMENTS

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