MADRES DE NEGRO

PONENCIA ANTE JUNTA PLANIFICACION
PLAN DE USOS DE TERRENOS
VISTAS EN ARECIBO, FRANCISCO "PACO" ABREU
2 DE FEBRERO DE 2015

Saludos de Madres de Negro:

La compareciente, señora Lucila Oliver Marqués, representa hoy a Madres de Negro, en carácter provisional. Comparecemos ante este foro con el ánimo de aportar las investigaciones y perpectivas que entendemos serán de mayor beneficio al uso de los terreno en nuestra querida región de Arecibo.

Arecibo cuenta con el privilegio de tener agua en abundancia. Contamos con el llano del Rio Grande de Arecibo, un sistema de acuiferos y un Caño, las cuales son areas inundables a tenor con nuestro conocimiento histórico; a su vez recogido en cada documento sobre el tema y en las agencias que manejan esa realidad, como lo es el Federal Emergency Management Agency, FEMA.

Tanta agua tenemos que en una reunión celebrada el 8 de noviembre de 2014, con el Ingeniero Héctor L. Quiñones, Director de Calidad Ambiental de la Autoridad de Acueductos y Alcantarillados, nos enteramos que la toma que queda en Cambalache le sirve agua hasta Caguas y Gurabo. Tambien nos informó que se está instalando una nueva toma que servirá a Hatillo y sus barrios. Arecibo le suple el agua a toda esa humanidad que se compone de dos terceras partes de la poblacion de la isla grande. Madres de Negro calcula esa masa de gente en un minimo de dos millones de personas.

Cuando hablamos del agua, nos referimos al bien mas importante que puede tener un pueblo. Si el agua se nos contamina, perdemos todos. Pierde la agricultura que no puede producir alimentos de calidad, ni desarrollar agricultura sustentable sin tener que invertir en descontaminar. Pierden las industrias cuando sus productos merman en calidad. Pierde el turismo cuando los turistas nos abandonan. Pierde el gobierno cuando los hospitales no pueden prevenir enfermedades, cuando la niñez nace con problemas de salud. Perdemos capacidad de trabajo, dias de empleo, la economia se descompone cuando la clase trabajadora se enferma mucho. El agua tiene que tener un tema especial en este Plan de Usos de Terreno. Todo lo que atente contra el agua tiene que ser sometido al analisis mas riguroso posible.

Este Plan de Usos de Terrenos denomina a Arecibo y su valle como rústico. Madres de Negro señala que eso es un error. Es un valle agrícola. Aparece en el Censo del

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2007 del United States Departmen of Agriculture, USDA, como un valle agricola. El tercer valle en importancia en la isla.

Cada año el Valle de Arecibo produce alrededor de 33 millones de dólares en bienes agricolas. Esa produccion se genera desde diferentes fuentes y beneficia a mucha gente, ya sea por medio de inyeccion económica, o de alimentos y agua. Arecibo impacta a toda la isla por su producción.

Sería un disparate cambiar esa producción por un millón de dolares que pague una patente municipal. Más disparatado aún, sería cambiar esa produccion por una tecnología que tiene dudosa ejecución. Nos referimos a la incineración.

Como Apendice de esta ponencia hemos incluído copias fieles y exactas de las imágenes de un libro publicado en el medio cibernetico *Google,* en el que el autor es el señor Patrick Mahoney, dueño de Energy Answers Limited Limited Company y admite que las cenizas de la incineracion y de "sus productos" son tóxicos. (https://books.google.com.pr/books?id=vfFVSYGvs8MC&pg=PA201&lpg=PA204&ots=ho8EOSdDLQ&focus=viewport&dq)

En ese libro, titulado *Waste Minimization Practices,* desde la pagina 196, el señor Mahoney admite que su tecnología produce ceniza volátil tóxica. Ese libro le sirvió de base a una conferencia presentada ante el Gobernador de New York en 1989 para presentar a su compañía de ese momento llamada Albany New York

MADRES DE NEGRO

Separation Waste Energy Recovery System, por sus siglas, ANSWERS. Energy Answers Limited Limited Company le ha hecho representaciones dolosas al gobierno. Alega que la tecnologia para disponer de las cenizas es tan novedosa que tiene que ser secreta. Que maneja toda la ceniza. Su libro expresa que esta diseñada para manejar "una fracción" de la ceniza de fondo. Con esa teoría pretende manejar toda la ceniza que se produciria en Arecibo consistente en ceniza volatil y ceniza de fondo.

Madres de Negro investigó la alegada tecnología. Encontró su Patente US 4917733. Relacionada a la Patente US 4,715,763 y a la WO1996000365A. Lo único secreto que tiene esa tecnologia es que la Patente de los Estados Unidos US 4917733, adscrita al señor Patrick Mahoney, para manejar las cenizas toxicas está expirada y no existe la alegada tecnologia novedosa que alega. Si se lee las acciones legales de la Patente, se encuentra que está expirada y no renovada con ninguna otra. Energy Answers pretende convertir la ceniza en bloques de cemento y concentrarla en algun punto de la isla, junto a una entidad de nombre LSC Environmental; o disponer de ellas en nuestros vertederos sabiendo que sus filtros contienen ceniza tóxica y nuestros vertederos no estan preparados para ceniza toxica. Sus acciones son dolosas porque su Patente expresa en su descripcion detallada que para poder procesar la ceniza requiere de cal. La pregunta inmediata que surge es si los mogotes de la isla se le entregaran a Energy Answers para que utilice su cal. En otras palabras, si le entregaremos nuestro sistema del carso para que dispongan de él, y con él de nuestra belleza escénica, capacidad pluvial, capacidad de recarga de los acuíferos, las actividades económicas que se derivan de ellas, la sustentabilidad agrícola, etc.

Otra vez Arecibo estaría impactando a la isla. Esta vez, en vez de con agua, alimentos, y dinero, como lo refleja el Censo Agrícola del 2007, sería con un promedio 1575 toneladas diarias de gases y alrededor de 525 toneladas diarias de cenizas y la devastación de la zona del carso.

La toma de agua del super tubo queda a menos de tres kilómetros de donde pretende autorizarse el incinerador. Según la Sociedad Británica de Medicina Ecológica, los vientos del incinerador impactan directamente hasta 20 millas a favor del viento. Energy Answers va a impactar desde Quebradillas, por via aérea; hasta Gurabo por via del agua y toda la zona del carso norteño por via de sus necesidades de alcalinizar su engendro tóxico. Ciertamente, esa es una realidad que este Plan de Usos de Terrenos no puede ignorar. Se anejan copias fieles y exactas de las imágenes del libro y las patentes, según copiadas de internet.

Atentamente,

Lucila Oliver Marqués
Portavoz interina

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form and quantities found in typical household products, can pose health threats if inhaled, absorbed, or ingested by humans or wildlife. Therefore, to avoid simply exchanging the hazards of improper landfilling for the potential hazards of waste combustion, proper treatment and disposal of bottom ash and fly ash is imperative.

Preliminary studies have determined that post-combustion processing to remove ferrous metals, nonferrous metals, and oversize fraction of the bottom ash stream yields a product similar in physical and structural properties to conventional aggregates [1–3].

Energy Answers Corporation (EAC) has undertaken an exhaustive research and development program to assess the feasibility and possible environmental impacts of using a selected fraction of the bottom ash stream (hereafter called Boiler Aggregate®) from PRF fired boilers as an aggregate substitute, in conjunction with recycling the ferrous and nonferrous metals. The research program was initiated by EAC of Albany, NY, with the State University of New York (SUNY) College of Environmental Science and Forestry, Smith and Mahoney, P.C., and Rensselaer Polytechnic Institute. The purpose of the research program is to develop more detailed data on the characteristics of Boiler Aggregate® and concrete products made from Boiler Aggregate® during exposure to rain and weathering in proposed applications. Such data will be used to market Boiler Aggregate® for uses that pose little risk to human or environmental health and safety, thereby alleviating pressure on limited landfill capacity. Other research efforts that focused on the use of ash residues are not specifically related to EAC's intended uses.

Recent literature concludes that fly ash consistently exhibits hazardous characteristics, while bottom ash does not [4–7]. Because the issue of toxicity is likely to determine if end products made from Boiler Aggregate® will be acceptable to the public, it is imperative to the future of ash utilization/minimization efforts to keep bottom ash separate from fly ash.

Procedure

The "third generation" PRF approach to waste disposal, implemented by EAC as developer of the SEMASS Waste-to-Energy Project in Southeastern MA (under construction), is one that seeks to optimize recovery of usable materials and minimize the environmental impacts of subsequent waste treatment and disposal. EAC's utilization strategies reflect policies being adopted by municipalities and industries across the country [8]. These strategies are

(1) to reduce waste generation,
(2) to recycle and reuse wherever possible,
(3) to combust and recover energy where possible, and
(4) to landfill only as a last resort.

A brief description of the waste combustion technology and bottom ash testing program follows. Refuse is processed to remove ferrous metal before shredding, which produces a homogeneous PRF with a reduced particle size and increased higher heating value. PRF facilities offer greater opportunity for materials recovery and recycling, and produce a bottom ash that is more granular and cleaner, and lends itself to further separation and the recovery of readily marketable metals as well as an aggregate material [2]. Figure 1 is a schematic of the EAC bottom ash processing operation. Nonrecoverable wastes, both municipal and light commercial, are burned to generate energy, and the residual bottom ash and fly ash streams may be processed and utilized to the extent possible. Fractions of the ash stream that are not useable, mainly larger than oversize clinker and fly ash, which

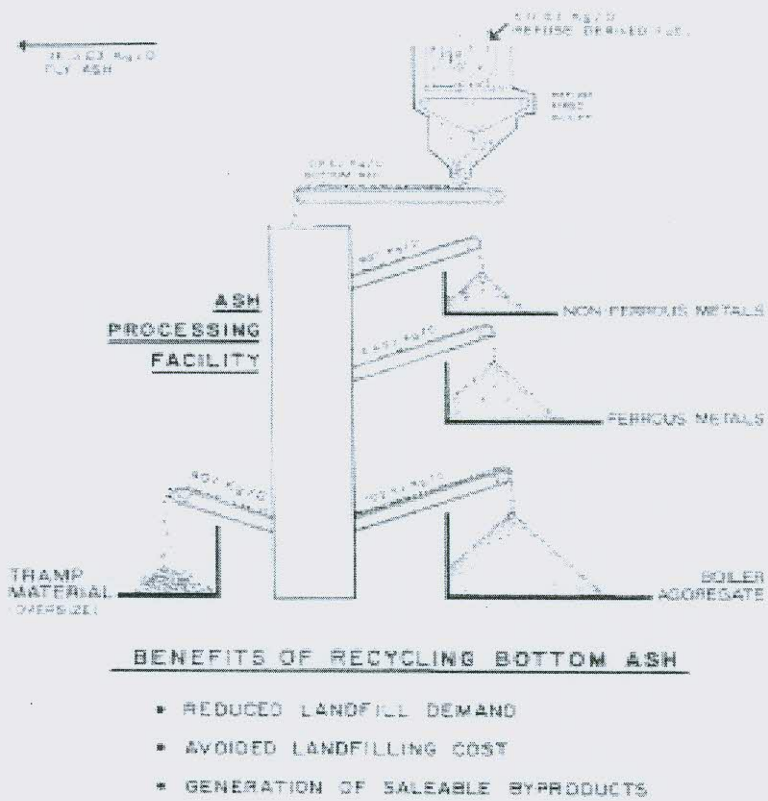

FIG. 1—*Boiler Aggregate® production concept.*

may contain excessive amounts of regulated metals and organics, will be stabilized and landfilled until appropriate uses are found.

Source of Ash Materials

Bottom ash is obtained from the City of Albany, which is responsible for the disposition of all ash (bottom and fly) produced at the New York State Office of General Services (NYSOGS) Boiler Facility on Sheridan Avenue in Albany (part of the ANSWERS Project). ANSWERS serves 13 communities in the Capital District receiving residential and commercial waste.

Bottom Ash Sampling

Bottom ash is sampled on a daily basis throughout the course of a year. Sampling is done in a random manner as prescribed by ASTM Practice for Sampling Aggregates (D 75), ASTM Practice for Random Sampling of Construction Materials (D 3665) and ASTM Recommended Practice for Probability Sampling of Materials (E 105). Together, these standards ensure that sampling is performed in a random manner and in great enough quan-

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tities to provide acceptable quality and quantities of data to determine the statistical significance of the results. Daily samples are composited over two 2-week periods each month to ensure that the samples are indeed representative of the bottom ash produced over that period. One complete analysis is done on each two-week composite to generate enough data for a rigorous statistical analysis.

Each month for a year, sampling proceeds as described above. Bottom ash composited every two weeks is labeled and stored in the event that subsequent testing indicates a need for further testing of products manufactured with Boiler Aggregate® from a specific compositing period.

Bottom Ash Processing

Boiler Aggregate® is produced with a pilot-scale system assembled within the City of Albany's ANSWERS Waste Processing Facility on Rapp Road. Processing involves magnetic removal of metals and oversize material, leaving the −½-in. (12.7-mm) particle fraction, which we refer to as Boiler Aggregate®. Figure 1 provides a description of the processing system.

Over 95% of the materials produced are considered readily marketable, and products produced in the subsequent operation of the facility have been successfully used in manufacturing concrete products. Both ferrous and mixed nonferrous scrap have been sold under contract, documenting the success of EAC's separation approach in producing marketable recycled materials.

Specific project tasks include (1) the production, sampling, and testing of the Boiler Aggregate® over a full year to assess the variability of its physical and chemical characteristics, (2) a simulation of stockpiling and storage of Boiler Aggregate® to determine its potential environmental impacts, (3) the production of concrete products made from Boiler Aggregate® for performance and environmental testing, and (4) an assessment of the suitability of Boiler Aggregate® for its proposed uses based on environmental, handling, health, and safety criteria. Methods of stabilizing the remaining fly ash stream are also under investigation.

Bottom Ash, Aggregate, and Product Testing

Bottom ash, Boiler Aggregate®, and Boiler Aggregate® products are tested on a regular basis for major constituents such as silicon (Si), aluminum (Al), iron (Fe), carbon (Ca), sodium (Na), potassium (K), phosphorus (P), and sulfur (S), 18 metals, including silver (Ag), aluminum (Al), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickle (Ni), lead (Pb), tin (Sb), selenium (Se), magnesium (mg), vanadium (V), tellurium (Tl), boron (B), and zinc (Zn), and select priority pollutants. Dioxin, furan, and polychlorinated biphenyl (PCB) (screen) tests are run one time per month on the composited bottom ash and at random intervals on product leachate, unless preliminary results indicate the need for closer monitoring. Samples for full PCDD/PCDF tests are taken according to Resource Conservation and Recovery Act (RCRA) Method 8280 and sent to a qualified outside laboratory for testing following approved chain of custody procedures.

Physical characteristics that are monitored include

(1) grain size distribution,
(2) moisture content,
(3) density and specific gravity,

(4) cation exchange capacity,
(5) percentage constituent materials,
(6) compactibility, and
(7) percentage metals.

Tests are performed twice monthly to determine the variation in bottom ash characteristics over the year as a function of seasonal variation in the solid waste input stream. Extended, open-pile storage of the Boiler Aggregate* is being studied to determine the nature of the leachate generated as a result of incident rainfall. 6-m (20 ft) lengths of 46-cm (18-in.) diameter plastic pipe are used to simulate a worst-case scenario in which all incident precipitation percolates through the pile instead of running off the pile. Test columns are saturated with distilled water, then irrigated with approximately 1 m/year rainfall at pH = 4. Leachate generated is collected and analyzed for organics, inorganics, and pathogens found in the bottom ash during preliminary bulk analysis. Identification and quantification is done by gas chromatography/mass spectrometry and atomic absorption spectrometry as described in the section on *quality assurance and quality control* which follows shortly.

Product Testing Program

Products were manufactured from Boiler Aggregate* composited during the first month, and were subjected to the full range of environmental and structural testing described below. If data gathered during subsequent homogeneity tests indicates that the chemical and physical properties of the bottom ash vary significantly from month to month, more products will be manufactured from:

(1) batches from the month showing the highest leaching potential, and the month showing the lowest leaching potential, and
(2) batches from the month showing the highest concrete strength potential (to be determined from results of the gradation and California Bearing Ratio (CBR) tests and other test results, if appropriate), and from the month showing the lowest concrete strength potential.

Blocks, cylinders, and other structural products also undergo leaching potential tests as well as simulated weathering tests. Freeze/thaw cycles are incorporated according to ASTM standard practices to determine if more chemicals are released after freeze/thaw. Weathering periods of three months, six months, one year, two years, five years, ten years, and twenty years are simulated by varying the flow through the products to correspond with the volume of accumulated rainfall for each weathering period, with corresponding numbers of freeze/thaw cycles.

Quality Assurance/Quality Control (QA/QC)

All test procedures follow protocols specified in the ASTM 1986 Books of Standards; *Standard Methods for the Examination of Water and Wastewater*, 16th ed.; *EPA Methods for Chemical Analysis of Water and Wastes*, and *EPA Test Methods for Evaluating Solid Waste-Physical/Chemical Methods SW-846*.

Detailed quality assurance/quality control procedures for chemical analysis are outlined in the references given above, and include the following:

(1) equipment calibration using prepared standard solutions before every test run,
(2) secondary identification procedures to support or disprove initial findings,

(3) preparation and clean-up techniques to prevent sample or equipment contamination, and

(4) the use of spiked samples of known concentrations during test runs to check results and determine the actual percent recovery based on established quality control criteria for each substance.

All appropriate QA/QC procedures are followed to ensure accurate and precise results.

Results and Discussion

Initial results generated during the course of EAC's long-term testing program support the use of Boiler Aggregate® as an aggregate substitute in many applications. Data from the open-pile storage simulation suggests that Boiler Aggregate® stockpiled outside and exposed to acid rain at pH 4 produces a leachate with negligible levels of heavy metals of concern (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Table 1 provides the relevant data.

The initial results of research on fly ash stabilization using cement kiln dust as the solidifying agent show that it is possible to contain high levels of metals such as lead and cadmium within a weak concrete matrix [*1*]. (Tables 2 and 3 provide the supporting data.) Future fly ash research efforts will focus on concrete additives that enhance the metal binding properties of concrete.

Research done independently by A/S Niro Atomizer on residues from spray dryer absorption units also support the use of lime and cement as containment media [*1*]. EP Toxicity test results for a typical sample of bottom ash and fly ash from the ANSWERS facility is presented in Table 4.

However, there are many regulatory, institutional, and logistical barriers to such promising and seemingly simple waste reduction strategies. While the spirit of solid and hazardous waste legislation may emphasize waste minimization, ambiguities in the regulations have undermined the actual intent, thus creating an environment of confusion and indecisiveness for the treatment and disposal of bottom ash and fly ash from resource recovery facilities.

TABLE 1—*Open pile storage simulation results of simulated exposure of boiler aggregate® to acidic rainfall ph 4.*

Material	Lead	Chromium	Cadmium	Silver	Iron	Zinc
Input						
Boiler aggregate® mg/kg	3304.6	30.0	7.0	1.6	<0.02	1300.0
Leachate						
Boiler aggregate®, mg/L						
Week 24	1.05	0.14	0.036	0.043	0.73	0.065
Week 20	0.85	0.092	0.016	<0.014	0.43	0.019
Week 30	0.89	0.034	0.013	0.03	0.33	0.043
Week 32	0.53	<0.015	0.013	<0.014	0.24	0.043
Week 34	0.43	<0.015	0.029	0.034	0.21	0.033
Week 35	0.63	<0.015	0.013	<0.014	0.18	0.043
Week 36	0.34	0.031	0.021	0.034	0.21	0.049
Week 37	0.43	<0.015	0.021	<0.014	0.18	0.049
Week 38	0.74	0.066	0.047	0.051	0.62	0.065

NOTE: All results were generated by methods outlined in "Assessment of the Utilization of Ash Aggregate Derived from Processed Refuse Fuel Bottom Ash."

16.45 million m^3 (581 million ft^3) of landfill space, a commodity that is becoming scarce. If the two streams are treated separately, the potential for recycling the bottom ash stream would decrease landfill capacity requirements by almost 11.33 million m^3 (400 million ft^3), and leave a smaller quantity of material that would require a more costly fixation/stabilization process before ultimate disposal. The implications for disposal capacity are significant.

As more and more municipalities and industries turn to resource recovery as the waste disposal method of choice, the amount of ash generated will increase dramatically. It makes little sense to impose strict and costly emission controls on combustion facilities and then ignore viable means of preventing residue dispersal after disposal.

Stabilization/solidification technologies under consideration for fly ash treatment and disposal include molten glass destruction and containment, polymer containment, and cement and other pozzolan containment matrices. Ongoing research toward a method of fixation that combines fly ash with other materials, and containment in a stable cement material block has shown great promise here and in Europe [*1*]. The separate treatment of bottom ash and fly ash probably enhances the potential for developing reuses for fly ash as well.

Ash disposal has become a major rallying point for opponents of waste-to-energy development. Therefore, it is reasonable to assume that the development of alternatives to the land disposal of residues may elicit more support for resource recovery as a viable disposal option. Decreasing the time needed to site and permit new plants will hasten the day when improperly designed and operated landfills will be closed, and prevent the recurrence of episodes like the "garbarge."

Scientists and environmentalists at EAC and elsewhere believe that the bottom ash stream is more appropriately utilized productively than as a diluent for the more hazardous fly ash stream.

References

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[*4*] Cross, F., Walsh, P., and O'Leary, P., "Residue Disposal From Waste-to-Energy Facilities," *Waste Age*, May, 1987.

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[*8*] "Draft New York State Solid Waste Management Plan," Report from the New York State Department of Environmental Conservation, Albany, NY, Dec., 1986.

[*9*] "Waste Age Refuse to Energy Guide", page 197, *Waste Age*, November 1986.

Author Index

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System for manufacturing ash products and energy from refuse waste

WO 1996000365 A1

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Patent Citations (6), Non-Patent Citations (1), Referenced by (4), Classifications (31), Legal Events (9)

External Links: Patentscope, Espacenet

ABSTRACT

The present invention provides a system of manufacturing energy and ash products from solid waste. The system includes apparatus for receiving solid waste for processing (200), apparatus for shredding the received solid waste (300), apparatus for removing ferrous material from the shredded solid waste (400) to create processed refuse fuel (PRF) and apparatus for efficiently combusting the PRF (600). A conveyor transfers the PRF to the combusting apparatus (600) such that a density of the PRF is always controlled for continuous non-problematic flow. Apparatus for recovering residual combustion particulate (656) from the combustion residual gases and for recovering solid ash residue (700) provides the system with the ability to generate steam and electrical energy, and to recover for reuse and recycling valuable materials (700, 650) from the solid ash residue.

DESCRIPTION (OCR text may contain errors)

CLAIMS (OCR text may contain errors)

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DESCRIPTION (OCR text may contain errors)

SYSTEM FOR MANUFACTURING ASH PRODUCTS AND ENERGY FROM REFUSE WASTE

BACKGROUND OF THE INVENTION

The present invention relates to a method and system for the recovery of resources from solid waste by efficient and environmentally sound combustion, the production of energy in the form of steam and electricity, the cleaning of combustion gases to remove undesirable combustion bi-products therefrom, and the manufacture of high quality ash products which can be separated into valuable reusable components.

It is a goal of this invention to provide a method of recovering resources by combusting solid waste as a means of manufacturing energy and ash, which will minimize or eliminate various problems and inefficiencies normally experienced in other methods used for the combustion of waste.

It is another goal of the invention to manufacture from solid waste combustion ash, an aggregate product which contains minimum amounts of combustible and metal materials so that valuable materials can be easily separated from the ash for recycling and/or reuse.

It is also a purpose of this invention to provide means for shredding solid waste in a single shredding stage that is followed by magnetic separation of ferrous metals in order to create a processed refuse fuel (PRF) that is capable of being burned "in-suspension" in a waterwall boiler. It is another purpose of the present invention to provide a dry bottom ash removal system capable of handling ash generated and providing it in free flowing form for processing without the

CLAIMS (OCR text may contain errors)

WHAT IS CLAIMED IS:

1. A system for manufacturing energy and ash products from solid waste, comprising: a solid waste receiving station for receiving solid waste: a solid waste shredding apparatus for generating shredded solid waste from said received waste; apparatus for removing ferrous material from said shredded solid waste to generate processed refuse fuel (PRF) ; a furnace system for combusting said PRF to generate steam and ash products; and apparatus for transferring said solid waste between each of said station and apparatus, and said PRF through said furnace system such that a flow density of said waste and said PRF is decreased.

2. The system as defined by claim 1, further comprising: a furnace exhaust pollution control system, wherein said pollution control system captures particulate matter and neutralizes acid gases generated during combustion and present within furnace exhaust gases.

3. The system as defined by claim 2, wherein said furnace exhaust pollution control system includes means for removing NO_x formed and present in said exhaust gases.

4. The system defined according to claim 1, wherein said receiving station comprises: at least one of a collection truck discharge area, a trailer discharge area, and a rail car transfer apparatus that includes a railcar discharge area; and an area for storing discharged solid waste. 5. The system defined according to claim 1, wherein said apparatus for transferring said solid waste between said station and said shredding

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addition of water except for dust control

It is another purpose of this invention to provide an improved method for moving waste for processing

It is yet another purpose of the invention to keep the fly ash separate from boiler bottom ash in order to facilitate the neutralization and stabilization of heavy metals contained therein and to provide an opportunity for the recovery and reuse of the neutralized and stabilized fly ash

As a net result of these purposes, it is the intent of this invention to recover as much energy and reusable material from waste as is practical and to approach zero disposal requirements

SUMMARY OF THE INVENTION

These and other purposes, goals and objectives are achieved in the present invention with a system for manufacturing energy and ash products from solid waste. The system includes a station for receiving solid waste for processing and separating out a portion of solid waste ■ which cannot be shredded and processed. Examples of non- processable wastes are bulky items, stringy items, appliances, etc. The non-processable portion of the waste is disposed of in a properly designed and permitted landfill. Also included in the invention is apparatus for removing ferrous material from the shredded solid waste to create processed refuse fuel (PRF), apparatus for delivering the PRF directly to the furnace system or to storage, and apparatus for retrieving PRF from storage and feeding the PRF as needed into the furnace system

Apparatus for storage and/or feeding transfers the processed refuse fuel (PRF) in a manner such that a density of the processed refuse fuel is always controlled for continuous non-problematic flow. Apparatus for treatment of

apparatus includes at least a first and second conveyor, the second conveyor operating at a higher rate of speed than the first conveyor such that the depth of solid waste transferred from the first to the second conveyor is reduced

6. The system defined according to claim 1, wherein said solid waste shredding apparatus may include at least one hammermill-type shredder

7. The system defined according to claim 1, wherein said apparatus for removing ferrous material includes an electromagnet positioned proximate to the flow of said shredded refuse waste, whereby said electromagnet attracts and recovers a substantial portion of ferrous material from the flow of said shredded solid waste

8. The system defined according to claim 7, wherein said apparatus for transferring includes at least two conveyors in series for transferring shredded waste between said apparatus for shredding and said apparatus for removing ferrous materials

9. The system defined according to claim 8, wherein said at least two conveyors operate at different speeds and different feed directions to accommodate site

■ specific needs and to reduce the flow density while maintaining a controlled flow volume of said solid waste.

10. The system defined according to claim 8, wherein said apparatus for transferring includes at least a third conveyor for transferring said removed ferrous material from said apparatus for removing ferrous material to said bulk ferrous storage means. 11. The system defined according to claim 10 wherein said apparatus for transferring includes at least a fourth conveyor for transferring said PRF from said apparatus for removing ferrous material

Apparatus for storage and/or feeding transfers the processed refuse fuel (PRF) in a manner such that a density of the processed refuse fuel is always controlled for continuous non-problematic flow. Apparatus for treatment of residual gases created from the burning of solid waste is included. The treatment includes, but is not necessarily limited to, neutralization of acid gases, capture of particulate matter, reduction of NO_x and mercury removal.

The solid waste receiving station can include provisions for the receipt of waste from all or some of collection vehicles, transfer trailers, railcars and barges. If provision is made for receipt of waste in railcars, the facility will include equipment and apparatus for removal of railcar covers, if any, and equipment for the removal of the waste from the railcar. One device which can be used for this last purpose is a Rotary Dumper

The solid waste shredding apparatus includes a hammermill-type shredder having a vertical or a horizontal main shaft. The shredder is equipped with an explosion suppression system which activates when an explosion has begun in order to quench the explosion before it reaches full force. A further method of avoiding explosions is to provide gas monitoring devices inside and beyond the shredder. Upon identification of a volatile gas level approaching the explosion point, the sensors will cause an increase in the air flow through the shredder and slow down or stop the waste feed to the shredder. Apparatus for removing ferrous material includes an electromagnet positioned proximate to the shredded waste flow, preferably utilizing a multi-stage overhead, hockey- stick shaped electromagnet.

PRF can be fed directly to the combustion system by means of a belt conveyor feeding onto a metal proprietary "Conveyor System for Shredded Solid Waste Material." The conveyor system is disclosed in U.S. Patent No. 4,997,081, incorporated herein by reference. However, other systems for the distribution of

ferrous material from said apparatus for removing ferrous material to said bulk ferrous storage means. 11. The system defined according to claim 10, wherein said apparatus for transferring includes at least a fourth conveyor for transferring said PRF from said apparatus for removing ferrous material to said furnace system, said fourth conveyor operating at a speed that reduces and controls the flow density of said PRF.

12. The system defined according to claim 11, wherein said fourth conveyor apparatus includes a mechanism that provides for storage of excess PRF and feeds a metered quantity of said PRF to said feeder system.

13. The system defined according to claim 12, wherein said mechanism for storage includes: a conveying system for feeding PRF to multiple storage bins and transportating excess PRF thereat for future use where said multiple storage bins are located proximate to the feed chutes through which the PRF is introduced into the furnace.

14. The system defined according to claim 13, wherein said mechanism includes multiple vibrating feeder conveyors, multiple furnace feed chutes, and means for agitating said storage bins in order to induce PRF therein to be shaken out onto a feeder conveyor to carry the PRF to the furnace feed chutes.

15. The system defined according to claim 14, wherein said mechanism for storage includes a fifth conveyor for removing and transferring the PRF to an auxiliary storage area for later use.

16. The system defined according to claim 1, wherein said furnace system includes at least one boiler into which said processed refused fuel is input for combusting. 17. The system as defined according to claim 15, wherein said at least one boiler, comprises: a furnace; a furnace fuel input conduit

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PRF can be fed directly to the combustion system by means of a belt conveyor feeding onto a metal proprietary "Conveyor System for Shredded Solid Waste Material." The conveyor system is disclosed in U.S. Patent No. 4,997,081, incorporated herein by reference. However, other systems for the distribution of PRF into multiple surge storage bins may be substituted therefor. Alternatively, PRF can be fed to the PRF Storage area for subsequent feeding to the boiler feed system.

The boiler feed system includes surge storage bins close to the boiler feed chute to provide a reliable, controllable flow of PRF onto variable speed conveyors which feed PRF into the boiler feed chutes. The boilers are each fitted with multiple feed chutes; one surge storage bin and one variable speed conveyor are required for each feed chute. Each boiler includes a boiler combustion zone (furnace) proximate to said fuel feed chute and horizontal metal travelling grate positioned at the bottom of the furnace.

Ductwork from the exhaust of the boiler gas outlet carries the exhaust gases to an acid gas neutralization system which can be a spray drier absorber or other technology available from manufacturers of alternate equipment for the neutralization of acids. Upon exiting the spray drier, the now neutralized exhaust gases are passed through an electrostatic precipitator or a fabric filter (baghouse) for capture of light particulate (fly ash). Fly ash from the air preheater hoppers located in the boiler house, fly ash from the acid gas control equipment hoppers, and fly ash from the particulate removal equipment hoppers is collected in either a pneumatic or mechanical conveyor system and stored in a silo. As the silo becomes full, the fly ash is discharged through a pugmill to which is added stabilization materials for the locking in of heavy metals. The fly ash stabilization process is disclosed in U.S. Patent No. 4,917,733, incorporated herein by reference. The stabilized fly ash is then discharged into vehicles for removal from the site.

16. The system defined according to claim 1, wherein said furnace system includes at least one boiler into which said processed refused fuel is input for combusting. 17. The system as defined according to claim 16, wherein said at least one boiler, comprises: a furnace; a furnace fuel input conduit for inputting PRF to said furnace; a traveling grate within said furnace; a combustion zone above said travelling grate; a furnace combustion air intake conduit; a furnace combustion gas exhaust conduit; a furnace water intake conduit in fluid communication with a plurality of tubes which comprise the walls of said furnace, the superheater, screen tubes and generating tubes; and an air distributing outlet wherein a substantial amount PRF is fluidized by heated gases in said combustion zone and suspension burned above a travelling grate thereby heating said water to steam.

18. The system defined according to claim 17, wherein said combustion air intake conduit includes means for preheating the air to increase the efficiency of said suspension burning.

19. The system defined according to claim 16, wherein said at least each boiler further includes a nitrous oxide emissions controller if so required by regulations.

20. The system defined according to claim 16, wherein each boiler includes a combustion residue recovery system.

21. The system defined according to claim 20, wherein said combustion residue recovery system comprises a dry bottom ash collection apparatus for transporting dry bottom ash to an ash processing facility. 22. The system defined according to claim 17, further comprises a steam turbine electrical generator for generating electricity from said generated steam, said steam turbine having direct controlled steam extraction capabilities so

equipment hoppers, and fly ash from the particulate removal equipment hoppers is collected in either a pneumatic or mechanical conveyor system and stored in a silo. As the silo becomes full, the fly ash is discharged through a pugmill to which is added stabilization materials for the locking in of heavy metals. The fly ash stabilization process is disclosed in U.S. Patent No. 4,917,733, incorporated herein by reference. The stabilized fly ash is then discharged into vehicles for removal from the site.

Bottom ash created in the combustion zone is discharged to the bottom ash collection system through proprietary hoppers onto rubber belt conveyors for transport to the receiving bunker of a proprietary Ash Processing Facility. The bottom ash collection system may embody the design disclosed in U.S. Patent No. 4,715,763, incorporated herein by reference. The proprietary ash processing facility is disclosed in U.S. Patent No. 4,669,397, incorporated herein by reference.

The combustion system includes an emissions monitoring system comprising a clean emissions pipe for receiving the combustion residual gases, a clean emission stack in communication with the clean emissions pipe and the clean emissions monitoring means for monitoring contaminant levels within gases exhausted from the clean emissions stack.

For a better understanding of the present invention, reference is made to the following description and drawings, the scope of which is defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is schematic block diagram showing a preferred system for manufacturing energy and ash products from solid waste of this invention;

Figure 2 shows a side perspective view of solid waste receiving station, including a partial cutaway vview of a waste receiving building.

a combustion residue recovery system.

21. The system defined according to claim 20, wherein said combustion residue recovery system comprises a dry bottom ash collection apparatus for transporting dry bottom ash to an ash processing facility. 22. The system defined according to claim 17, further comprises a steam turbine electrical generator for generating electricity from said generated steam, said steam turbine having direct controlled steam extraction capabilities so that a percentage of the steam can be used directly at one of on and off site locations.

23. The system defined according to claim 22, wherein said steam turbine electrical generator comprises: a steam turbine in communication with said steam distributing outlet; an electrical generator in communication with said steam turbine; an electrical transfer circuit responsive to said electrical generator; a spent steam discharge conduit; and a steam extraction port.

24. The system defined according to claim 22, wherein said steam turbine generator further comprises a condenser in communication with said steam return conduit.

25. The system defined according to claim 17, wherein said furnace exhaust pollution control system comprises: an acid gas neutralization system in communication with said combustion gas exhaust outlet; and an apparatus for recovering particulate from said exhaust gas.

26. The system defined according to claim 25, wherein said apparatus for recovering particulate includes one of an electrostatic precipitator and baghouse in connection with said acid gas neutralization system. 27. The apparatus defined according to claim 25, further including a fly ash storage and stabilization means in communication with said particulate recovery apparatus

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Figure 2 shows a side perspective view of solid waste receiving station, including a partial cutaway vviiew of a waste receiving building

Figure 3 is a schematic diagram highlighting one portion of the solid waste receiving station of Figures 1 and 2;

Figure 4 is a schematic representation of apparatus for removing ferrous material;

Figure 5 is a plan view of a processed refuse fuel conveyor system of this invention.

Figure 6 is a side sectional view of a processed refuse fuel conveyor system shown in Figure 5

Figure 7 is a view highlighting one type of tine- type drag elements utilized in a system shown in Figures 5 and 6,

Figure 8 shows the surge storage, variable rate PRF feed apparatus and fuel feed chutes according to the present invention

Figure 9 is a side cross sectional view of a feeder system of this invention;

Figure 10 is a schematic side cross sectional view of the furnace system of this invention. Figure 11 is a schematic diagram depicting an air pollution control system of the present invention.

Figure 12 is a schematic diagram of the fly ash silo including the mixing mills and stabilization system, and

Figure 13 is a schematic block diagram highlighting the flow through the bottom ash processing system of this invention.

baghouse in connection with said acid gas neutralization system. 27. The apparatus defined according to claim 25, further including a fly ash storage and stabilization means in communication with said particulate recovery apparatus.

28. The system defined according to claim 27, wherein said particulate recovery apparatus further comprises a fly ash transfer apparatus for transferring said fly ash to means for storage and stabilization.

29. The system defined according to claim 17, further comprising a clean emissions system responsive to said combustion residual gases

30. The system defined according to claim 29, wherein said clean emissions system comprises: a clean emissions pipe in communication with said combustion gas exhaust conduit: a clean emissions stack in communication with said clean emission pipe: and a clean emissions monitoring apparatus for monitoring contaminant levels within gases passing through said clean emissions stack.

31. A method for manufacturing energy and ash products from solid waste, comprising the steps of: receiving solid waste at a waste processing facility; transferring said solid waste to a shredding apparatus such that a flow density of said solid waste is reduced; shredding said received solid waste for processing; transferring said waste to a ferrous materials separator such that a flow density of said shredded solid waste is reduced; separating ferrous materials from said shredded solid waste thereby generating processed refuse fuel (PRF) : transferring said removed ferrous materials to ferrous materials storage area such that ferrous materials may be sold for re-use: transferring said PRF to said furnace system such that a flow density of said PRF is reduced: and combusting said PRF to generate steam and high quality granular ash.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In accordance with the present invention, a system and a method for manufacturing energy and ash products from solid waste is provided. The system may be interchangeably referred to as a "shred-and-burn" combustion system

The "shred-and-burn" combustion system of the present invention was developed to obtain certain advantages over the more widely-used mass-burn methods of waste combustion. These advantages are 1) an increase in the amount of energy produced per unit measure of waste, 2) reduced capital costs, 3) recovery of valuable usable materials prior to combustion and from the ash, 4) reduction in the final amount of material which must be sent to landfills, 5) reduced water usage, 6) elimination of water pollution caused by quenching of ash and 7) stabilization of fly ash to permanently bind heavy metals

There are three major distinct but interconnected subsystems which makes up the present invention:

Subsystem 1 The Waste Receiving and Fuel Preparation system (WRFP) Subsystem 2 The Fuel Combustion system including generation of energy and air pollution control (FC) Subsystem 3 The Ash Processing system (AP) for the separation and recovery of valuable usable materials from the ash manufactured in the FC

32. The method defined by claim 31, further comprising the step of transferring said PRF to a storage area for later use.

33. The method defined by claim 31, further comprising the step of generating electricity from said steam

34. The method defined according to claim 31, wherein said step of receiving solid waste includes accepting solid waste from at least one of a collection truck, a solid waste transfer vehicle, a barge, and a railcar, and, storing the received solid waste in a solid waste storage area.

35. The method defined by claim 34, wherein the step of receiving solid waste from said railcar includes

- gripping and overturning said railcar to unload said solid waste onto an area having a greater volume than the volume of said railcar thereby decompacting said solid waste.

36. The method as defined by claim 31, wherein said step of separating includes removing ferrous material from said shredded solid waste using at least one electromagnet. 37. The method defined according to claim 31, wherein said step of combusting includes generating said steam, combustion residual gases and solid ash residue in at least one boiler.

In the preferred arrangement, all three subsystems are connected together on one site. However, it is also contemplated to have the subsystems at sites remote from each other with the appropriate products being transported from site to site by various material moving methods. For example, waste could be received at a WRFP site where it would be processed in accordance with this invention to create a fuel (Processed Refuse Fuel or PRF). The PRF would then be taken by conveyor (if close enough), or by truck, train or other conveyance to the FC. Ash manufactured in the FC could be transported by conveyor (if close enough), or by truck, train or other conveyance to the

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products being transported from site to site by various material moving methods. For example, waste could be received at a WRFP site where it would be processed in accordance with this invention to create a fuel (Processed Refuse Fuel or PRF). The PRF would then be taken by conveyor (if close enough), or by truck, train or other conveyance to the FC. Ash manufactured in the FC could be transported by conveyor (if close enough), or by truck, train or other conveyance to the AP.

For convenience and clarification, in the present invention, the various equipment are described in singular terms. Usually a facility will include multiple systems and subsystems depending on the production capacity of the facility.

Facilities and/or subsystems of the present invention may include a receiving building for the receipt and storage of raw solid waste, a shredder for shredding the waste to a size which will permit burning of the lighter portion of the PRF in suspension to ensure efficient combustion, an indoor area or separate building for the storage of PRF, a boiler for the generation of steam energy, a steam turbine to provide electricity, multiple steam turbines to drive mechanical equipment, steam piping system to provide heating, cooling or industrial process steam.

Specifically, referring now to Figure 1, the structure of the system 100 of the present invention is described. Solid waste receiving station 200 receives and stockpiles incoming solid waste, typically municipal and household waste. Operators search the unloaded solid waste for unacceptable waste materials. Examples of unacceptable materials are appliances, large carpets, stringy materials, hazardous waste, highly volatile material, tree stumps, etc. The unacceptable waste materials are transferred to trailers for off-site transportation and disposal. In the case of hazardous waste, the material is stored in a locked storage area until subsequently disposed of in accordance with regulations governing the transport and disposal of hazardous wastes.

The remaining solid waste is then transferred via a conveyor system to solid waste processing apparatus 300 which shreds the solid waste. The shredded waste is separated into a ferrous materials portion and a Processed Refuse Fuel (PRF) portion at an apparatus for removing ferrous material 400. The removed ferrous materials are removed from the site for recycling while the PRF is transferred to the furnace system 600 either directly or via apparatus for storage and/or feeding 500.

The PRF is combusted within furnace system 600 to generate energy and ash products. Heated exhaust gases generated during combustion are output by the furnace system and directed to economizer 633 and air preheater 632 to preheat

The PRF is combusted within furnace system 600 to generate energy and ash products. Heated exhaust gases generated during combustion are output by the furnace system and directed to economizer 633 and air preheater 632 to preheat water and combustion air, respectively. The preheated water and combustion air are used to maintain ideal combusting conditions within the furnace system. The exhaust gases, which contain, heavy fly ash are transferred through the economizer 633 and air preheater 632 where the heavy fly ash is removed and sent to fly ash storage and stabilizing apparatus 650. There, the fly ash is stabilized for disposal or further processing and reuse or disposal. The exhaust gases are provided to spray drier absorber 654 within which acid gases are neutralized. Exhaust from spray drier absorber 654 is directed to particulate collection apparatus 656 for particulate collection, and then on to continuous emissions monitoring and for stack 670 testing before being exhausted to the air. The particulate collected from apparatus 656 is also provided to storage and stabilizing apparatus 650.

The furnace system 600 also includes means for directing the bottom ash directly to bottom ash processing system 700. BOILER AGGREGATE™, a granular aggregate product distributed by Energy Answers Corporation, Albany, New York, non-ferrous and post-combus ion-ferrous materials are separated and collected within bottom ash processing apparatus 700 for further processing.

The present invention, therefore, provides not only a system for generating (manufacturing) energy, producing ash-based building materials, ferrous metals and non- ferrous metals from solid waste, but also solves the ever increasing problem of solid waste disposal through a resource recovery approach. The waste-processing technology described herein overcomes the inherent problems of conventional solid waste combusting facilities which burn waste without prior processing. In particular, because of the varying consistency of solid waste, exacerbated by methods of trash compaction at collection, solid waste tends to coagulate or clog various points within conventional waste processing systems, causing bottlenecking. The consequences of solid waste flow bottlenecking can include equipment damage, excessive pollution and loss of income.

The waste processing flow of this invention is designed to avoid blockages that typifies conventional solid waste processing systems. More particularly, the various interfaces between the subsystems within the present system are designed to accommodate the smooth and free flow of waste PRF and ash products. Waste, PRF and ash products are always caused to flow from an area of lesser volume to an area of greater volume whereby the density of the waste and

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processing systems. More particularly, the various interfaces between the subsystems within the present system are designed to accommodate the smooth and free flow of waste PRF and ash products. Waste, PRF and ash products are always caused to flow from an area of lesser volume to an area of greater volume whereby the density of the waste and the probability of blockages may be minimized. Backups rarely occur in the present system.

The present invention can preferably be designed with multiple waste paths and processing subsystem redundancies. There can be several PRF storage areas and multiple paths for transferring the solid waste and PRF within the system. In addition, there can be multiple shredders and apparatus for removing ferrous material from the waste flow. Multiple boilers enable one boiler to be shut down for maintenance or rework without stopping disposal of municipal waste, or production of energy and ash products.

Referring to Figure 2, a preferred embodiment of the present system includes receiving building 202 as part of the solid waste receiving station 200. Receiving building 202 receives incoming solid waste which is to be to be processed, and stockpiles the received solid waste therein. Collection trucks 204 and transfer trailers 206 discharge their loads of solid waste at a portion of the receiving building referred to as the tipping floor 208. The waste unloaded onto the tipping floor 208 is then moved by front end loader or like machinery for processing. Rail cars 210 containing solid waste may also be unloaded within the receiving building 202. The waste content of the rail cars is dropped onto a portion of the tipping floor with the use of a dumping apparatus 220, sometimes referred to as a rotary dumper.

When a rotary dumper 220 is used for dumping the waste onto the tipping floor 208, it effects efficient transfer. First, a loaded railcar 210 is directed onto a movable rail track 222 within the solid waste receiving building proximate the tipping floor 208. The rotary dumper 220 includes a removal apparatus 223 for removing the railcar lid 225 to access the solid waste. The railcar is then clamped on to the moveable track 222 with clamping arms 224. The clamping arms 224 support and grip the moveable track and the railcar, lifting and rotating both approximately 140° so that gravity discharges the solid waste contained therein onto the tipping floor. Another advantage resulting from waste transfer in this way is a concomitant minimization of vehicular traffic flow into and out of the facility due to the large volummetric capacity of the railcars and its effect on the need for road vehicles to truck the waste in.

During the waste unloading and distributing operation at the waste receiving station 200, floor attendants and utility operators inspect the solid waste for hazardous, highly volatile or other unacceptable materials. Identified unacceptable materials 228 are segregated either manually or by machine and are periodically loaded into trailers 230 for off-site

During the waste unloading and distributing operation at the waste receiving station 200, floor attendants and utility operators inspect the solid waste for hazardous, highly volatile or other unacceptable materials. Identified unacceptable materials 228 are segregated either manually or by machine and are periodically loaded into trailers 230 for off-site transportation. In addition to visual inspection, hand held combustible gas detectors 232 may be used to identify potentially explosive items for removal. Hand held radiation detectors 234 also may be used to identify radioactive material for removal.

As shown in Figure 3, waste stored in the Receiving Building 202 (Figure 2) is moved by frontend loader 226 into a processing line pit 236 which contains a conveyor 244. Most facilities include multiple processing lines where each processing line is substantially identical. Preferably, processing line pit 236 includes two consecutive metal apron pan-type conveyors, 244 and 245.

The processing line is positioned proximate to the tipping floor 208 for convenient access to the solid waste.

When the solid waste is deposited into the processing pit 236, conveyor 244 lifts the waste and deposits it on a conveyor 245. Conveyor 245 is moving at a faster rate of speed than conveyor 244. This differential in conveyer speed causes the depth of the waste on conveyor 245 to be lower than that of conveyor 244 and enables adequate inspection of the waste by attendants at a picking station 246. Unacceptable waste 228 (Fig. 2) is removed at picking station 246 and placed in nearby trailer 230 (Fig. 2) for transport to the backup landfill.

Substantially all of the waste flow processing path is preferably monitored either visually by operators or by video cameras (not shown) for viewing at a central monitoring location. Consequently, any blockages may be quickly identified and remedied. Sensors, and computer processing of sensor-generated information may also be included to fail-safe system operation.

Solid waste processing apparatus 300 (shredding line) is also illustrated in Figure 3, at the end of conveyer 245, downstream from picking station 246. Preferably, however, as distinguished from Figure 3, multiple shredders and conveyors are provided by the present invention. The shredder preferably includes a hammermill-type shredder 302 that contains a rotor and hammers 303 which shred the waste into various size particles with a nominal maximum size of about 6 inches. The shredding decreases the density and increases the processing flowability of the solid waste. The smaller

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sized waste displays better flowability and is more readily combustible than unprocessed waste. A further advantage of the shredding of waste is that the shredding process reduces the odor which commonly emanates from solid waste. In addition, shredded waste does not attract rodents and vermin as does non-shredded waste.

Shredder 302 discharges the shredded waste through grates 304 onto impact-resistant rubber belt conveyor 305 immediately beneath the shredder discharge chute 304A. From conveyor 305, the shredded waste is transferred to rubber belt conveyor 401 to the apparatus for removing ferrous material as shown in Figure 4.

Specifically, as illustrated in Figure 4, the apparatus for removing ferrous material 400 includes rubber belt conveyor 401, which carries the material beneath overhead magnetic separator 408, preferably a hockey-stick shaped electromagnet, for the extraction of ferrous metals. The ferrous metal is discharged onto a conveyor 410 for loading into a storage area 411 or into a transfer vehicle 412. The balance of the shredded waste is now PRF.

The PRF is transferred to storage or onto a fuel feed system 500.

As illustrated in Figures 5, 6 and 7, the fuel feed system utilizes a rubber belt conveyer 510 which carries the PRF to the boiler house (proximate the boilers, see Figure 8) where it is discharged into an elongate, trough- like conveyor enclosure 513. Conveyor enclosure 513 includes a base 515 and a pair of opposing, parallel side walls 517 extending substantially perpendicularly from base 515. The enclosure 513 accordingly maintains a generally trough-like construction.

A plurality of discharge outlets 519 are mounted to the base 515 of the conveyor enclosure 513. The base 515 includes an opening 521 at each outlet 519 to provide access thereto. The trailing upper edge 523 of each discharge outlet 519 is rounded (i.e., cylindrical) or otherwise constructed so as to present no sharp angular corner against which conveyor material may jam or compact, causing blockage.

A flighted drag chain conveyor 525 is positioned within conveyor enclosure 513. The flighted drag chain conveyor 525, preferably includes a pair of drag chains 512, a plurality of flights 518 bolted to the drag chains 512 that extend laterally across the enclosure 513. A plurality of drag elements 522 are bolted to flights 518 and extend downwardly therefrom. The drag chains 512 are supported by a pair of opposing L-shaped brackets 524 which are in turn secured to side walls 517 of conveyor enclosure.

The preferred drag elements 522 are spring mounted, fork tine-type drag elements. One such drag element 522 includes a

drag chains 512 are supported by a pair of opposing L-shaped brackets 524 which are in turn secured to side walls 517 of conveyor enclosure.

The preferred drag elements 522 are spring mounted, fork tine-type drag elements. One such drag element 522 includes a U-shaped support 522a a pair of coil springs 522b integrally formed with the support, and a pair of tines 522c formed integrally with the respective coil springs 522b extending downwardly towards the base 515 of the conveyor enclosure. For handling of certain wastes which may become tangied to the tines, a metal plate can be welded across the ends of the tines. As well, different spring systems can be used. In operation, the drag chain 512 moves from left to right, causing the tines of the drag elements 522 to follow in that direction. The shredded solid waste fuel is urged along by the tines until it falls into one of a number of discharge outlets 519. When an outlet 519 is full, the material simply bypasses the full outlet and is pushed by the tines to the next available outlet 519. Further understanding of the present conveyer system may be derived from a reading of U.S. Patent No. 4,997,081, incorporated herein by reference.

There are multiple fuel storage and feed systems at each boiler. Figure 8 shows a typical redundant fuel storage and feed system 550. PRF discharged through outlet 519 of the fuel feed system 510 is captured in a surge bin 553 of feed system 550. Beneath the surge bin is a variable speed vibrating feeder 551 which carries PRF to the vertical chute 570 which feeds the PRF into the front of the boiler. The variable rate feeder 551 is electrically interconnected and is fitted with a level detecting device. When the PRF level drops below the desired level, the surge bin 553 is activated and discharges additional PRF onto the variable rate feeder 551 thereby regulating the flow of PRF into the boiler via chute 570.

The feeder system for feeding PRF into the boiler is illustrated in Figures 9 and 10. PRF material from variable rate feeder 551 (Figure 8) drops through the gravity feed chute 570 into the waterwall furnace section of the boiler at an elevation of up to 10 feet above a traveling grate 622. When the PRF falls to the bottom of the boiler feed chute, a deflector 625 changes the direction of the flow of the PRF upwards and air from the distribution air fan 627 blows the PRF into the boiler. As understood by the arrangement of Figure 10, the light material is carried upwards and catches fire within a combustion zone 626 where it is estimated that 40% to 90% of the PRF combusts, the heavier materials, both non- combustible and combustible, drop to the lower portion of the furnace where they land on the horizontal metal travelling grate 622. The grate moves slowly from back to front of the furnace during an adjustable period of time. Air is fed through holes in the grate to provide air for combustion of the combustible materials and to maintain a low temperature at the grate. By the time the heavy material has reached the front of the grate, all the combustibles have been consumed and the remaining ash (the bottom ash) falls off the grate into the proprietary ash hopper 623. Further description of the ash hopper is provided in

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U.S. Patent No. 4,715,763, incorporated by reference herein.

Combustion air is supplied by means of a forced draft fan 628 and an overfire air fan 629. Air for the intake of the overfire air fan is obtained from ducts drawing air from the receiving building 202. Drawing air from the receiving building creates a negative pressure zone in the building. The negative pressure acts to continuously draw air from the outside of the building in. Accordingly, the odor normally emitted from conventional enclosed raw waste storage facilities is eliminated with such a design.

An economizer 633 and an air pre-heater 632 are provided to pre-heat water and combustion air, respectively, before they are introduced into the boilers. The heat source for the economizer and air pre-heater is the exhaust gas leaving the boiler. The preheated water is provided at the boiler water inlet. The pre-heated air directed through two levels of overfire air-ports 634, 636 at the rear wall of the boiler, and one level at the front wall. Overfire air can also be introduced at the side walls in order to provide oxygen for combustion and to maintain flame turbulence. Distribution of air within the furnace in conjunction with high gas residence time resulting from the extended height of the furnace creates high gas temperatures for destruction of dioxins and furans. The high gas temperatures also ensure complete combustion of PRF, maximize steam production and minimize excess air to ensure maximum thermal efficiency within the combustion system.

The controls built into the furnace design also allow a variety of fuels with varying ash contents and combustion characteristics, such as automobile shredder residue and oily filter media, to be effectively combusted in the furnace. The boilers are typically operated at an excess air rate of 60% to 80%. The boilers may also be operated by combusting fuel oil or gas during startup or periods when the waste heating value is too low to support combustion.

The combined stoker/boiler system of this invention provides fuel for combustion, a proper distribution of under-grate air and a moving surface (traveling grate 622) for ash advance. The feeders may include a pneumatic distributor 646 which distributes the heavy fraction of the PRF evenly over the traveling grate 622 surface. A uniform, 6"-8" ash bed depth is typically maintained on the traveling grate 622 and provides for even distribution of air along boiler cross-section, i.e., the stoker length. The traveling grate 622 may be a moving chain/surface assembly supported by a framework of steel side frames and structural steel cross-members. Because of the combustion of the lighter portions of PRF in suspension and the shallow depth of material on the grate compared to other waste combustion systems, the amount of excess air is low. The low excess air level thus provides high thermal efficiency and therefore high electricity generation per ton of waste. Because of the physical characteristics of the PRF, no refractory linings are required to protect the boiler walls. Therefore,

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formation of slag does not occur on furnace walls so that slag removal and refractory repair and replacement are not required.

Nitrous Oxides (NO_x) are removed from the combustion system by a urea-based NO_x control or selective non- catalytic reduction system SNCR. A 50% urea solution is stored on site and is diluted with process dilution water obtained from the facility's industrial water supply system. The baseline NO_y level produced by the shred-burn technology for manufacturing ash products and energy from solid waste is low. Therefore, the urea flow rate required to maintain emissions below the permitted level is minimized. The controlled NO_y levels are maintained at a particular system set point. Urea injection nozzles 660 are provided in the front wall of the boiler. Additional nozzles could be installed in the side or rear walls and/or at different elevations.

Referring now to Figure 11, steam generated from the combustion of the PRF within furnace system 600 is carried in high pressure pipes 649 to a turbine/generator 450. Turbine/generator 450 extracts steam to provide mechanical or electrical energy therefrom. Exhaust steam from the turbine/ generator is condensed in a series of air-cooled, freeze-protected condensing systems 604, which include multiple variable speed fans (not shown in the figure). The water discharge from the condenser is returned to the boiler feed water system. Exhaust gases from the boiler are carried in a duct 648 into an acid gas neutralization Spray Dryer Absorber (SDA) 654. $Ca(0H)_2$ slurry is sprayed through a high speed atomizer wheel 652 into SDA 654. Injection of lime slurry can also be accomplished with the use of specially designed nozzles. Exhaust gases from air preheater outlet 651 enter the SDA at about 380°F. The $Ca(OH)_2$ slurry injection rate is controlled automatically in accordance with the stack sulfur dioxide ($S0_2$) set point by adjusting lime and water input in accordance with the amounts needed based on continuous monitoring of sulfur dioxide in the exhaust gases.

Gases leaving the SDA 654 are carried by ductwork 655 into the particulate collection apparatus 656. Particulate removal can be accomplished by particulate removal equipment 656 consisting of either multistage electrostatic precipitator or by fabric filters within a baghouse. Either apparatus may be the particulate collection apparatus 656.

The collected fly ash after neutralization and stabilization can be either utilized as a raw material in the production of usable products or disposed of in an approved landfill.

Figure 12 schematically shows the one embodiment of this invention for handling, stabilizing and disposing of fly ash. All

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The collected fly ash after neutralization and stabilization can be either utilized as a raw material in the production of usable products or disposed of in an approved landfill.

Figure 12 schematically shows the one embodiment of this invention for handling, stabilizing and disposing of fly ash. All fly ash generated in the facility is mechanically conveyed to a fly-ash storage silo 682 located on site. Two mixing mills 684 are provided at the bottom of the ash silo 682 to receive fly ash through a rotary air lock 686. A cementitious agent, such as cement kiln dust combined with water or leachate is pumped into the mixing mills to effect stabilization through chemical reactions. Water and/or landfill leachate is transported to the system in tanker trucks which unload their contents into the on-site storage tank 688. Kiln dust is delivered to the site by truck and stored in an on-site storage tank 688A. A high pressure pump is provided to pump the water stream into a sparger system located inside each mill 684. The sparger system consists of distribution piping and fine atomization spray nozzles that ensure uniform water application onto the mixing mill contents. In the event that leachate from tanker trucks is not available, waste water generated at the plant can be used in the fly ash stabilization system.

Each mixing mill 684 is provided with a dual screw system equipped with specially designed paddles which ensure uniform mixing and residence times required for the desired stabilization reactions. The mixed process stream is discharged through gravity chutes 685 into positioned trailers 697 underneath the stabilization processing room for transport to landfill, either directly or via conveyor 681. Within about 24 hours, the stabilized fly ash residing in the landfill cells hardens, approaching the consistency of concrete surfaces.

If additional fly ash storage capacity is required, multiple silos can be installed. Further description of the fly ash stabilization system is contained in U.S.

Patent No. 4,917,733, incorporated by reference herein.

Figure 13 is a flow chart of the Bottom Ash Processing System incorporated in this patent. Bottom ash from the boilers is conveyed on bottom ash conveyor 690 to ash conveyor 690a by which it is input to ash processing facility 700 on the site. The bottom ash may also be transported in vehicles for removal to an ash processing facility located at a remote site. In either case, the bottom ash is first discharged continuously into a storage area within the Ash Processing Facility while the furnace system 600 is burning PRF. Normal procedure is to burn PRF 24 hours per day, 7 days per week. The ash is processed one single shift per day, 7 days per week. Further description of the bottom ash processing system is provided

either case, the bottom ash is first discharged continuously into a storage area within the Ash Processing Facility while the furnace system 600 is burning PRF. Normal procedure is to burn PRF 24 hours per day, 7 days per week. The ash is processed one single shift per day, 7 days per week. Further description of the bottom ash processing system is provided
in U.S. Patent No. 4,669,397, incorporated by reference herein, and in the corresponding foreign patents.

With further reference to Figures 10 and 13, conveyor 690a provides bottom ash from the boilers to storage. From storage, bottom ash is conveyed to the in- feed vibrating hopper 710. Hopper 710 conveys the material at a controlled feed rate onto a primary belt conveyor 712. Preferably, permanent magnet system 714 is provided which separates the larger sized a ferrous metal fraction 716 of the ash stream and conveys the ferrous metal fraction to a dedicated trailer 717 (not shown in Figure 13) parked on site via conveyor 719.

The remaining ash 718 is discharged into a primary two-stage trommel system 720. The first stage 721 consists of a plurality of 5/8" holes. The fraction of ash 718 passing through these holes constitutes BOILER AGGREGATE™ ash product 722 and is passed to a loading conveyor 724 which transports the BOILER AGGREGATE™ ash product to a trailer 716 located at a load out bay 728 for this purpose. The 5/8"-plus fraction enters the second stage 730 which is provided with a plurality of 4" holes. The oversize fraction 731 (i.e., greater than 4") is discharged into a hopper 732 where it is manually sorted for ferrous and non-ferrous content. The 4" minus fraction 733 (from the second stage 730) is conveyed by a belt conveyor 734 to an impact mill 736 which reduces the size nominally to 2"- minus. The ensuing 2"-minus ash stream is transported by a belt conveyor 738 to a magnetic head pulley 740 which separates the residual ferrous fraction 742 and discharges the same to transfer belt 719. The transfer belt 719 conveys the residual ferrous fraction 742 into ferrous trailer 717 parked on site. The non-ferrous fraction 748 is discharged into a secondary single stage trammel 750 provided with 5/8" holes. The screened fraction 752, also characterized as BOILER AGGREGATE™ ash product, is conveyed to a series of belt conveyors 754 to combine with the aggregate fraction separated in the primary trammel 720. The BOILER AGGREGATE™ ash product is discharged via belt conveyer 724 into a container at a bay 723. Non- ferrous, non-BOILER AGGREGATE™ is discharged via conveyor 787.

Although illustrative embodiments of the present invention have been described, it is to be understood that the invention is not limited to those precise embodiments, and that further changes and modifications may be made by one skilled in the art without departing from the scope or spirit of the invention.

PATENT CITATIONS

DIRECCION POSTAL: APARTADO 1178, ARECIBO, PUERTO RICO 00613, ATENCION L. OLIVER
TELEFONO PORTAVOZ: (787) 354-0950;

PATENT CITATIONS

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US4669397 *	Aug 21, 1986	Jun 2, 1987	Smith & Mahoney, P.C.	Recovery of useful materials from refuse fuel ash
US4917733 *	Nov 14, 1988	Apr 17, 1990	Hansen David L	Mixture of fly ash and kilm dust
US4993331 *	Oct 31, 1989	Feb 19, 1991	Neutralysis Industries Pty. Ltd.	Mixing with binder, pyrolysis, oxidation, vitrification
US4997081 *	May 15, 1989	Mar 5, 1991	Eac Systems, Inc.	Conveyor system for shredded solid waste material
US5078065 *	Mar 13, 1991	Jan 7, 1992	Osaka Gas Co., Ltd.	Incinerating-fusing system for city refuse disposal
US5205227 *	May 21, 1991	Apr 27, 1993	Institute Of Gas Technology	Process and apparatus for emissions reduction from waste incineration

* Cited by examiner

NON-PATENT CITATIONS

	Reference
1 *	See also references of EP0763179A1

* Cited by examiner

REFERENCED BY

Citing Patent	Filing date	Publication date	Applicant	Title
WO2001009550A1 *	Jun 29, 2000	Feb 8, 2001	Abb Alstom Power Inc	Method and assembly for converting waste water accumulated in a fossil fuel-fired power generation system
WO2008079319A2 *	Dec 21, 2007	Jul 3, 2008	Robert L Barker	Method and systems to control municipal solid waste density and higher heating value for improved

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1 * See also references of EP0763179A1

* Cited by examiner

REFERENCED BY

Citing Patent	Filing date	Publication date	Applicant	Title
WO2001009550A1 *	Jun 29, 2000	Feb 8, 2001	Abb Alstom Power Inc	Method and assembly for converting waste water accumulated in a fossil fuel-fired power generation system
WO2008079319A2 *	Dec 21, 2007	Jul 3, 2008	Robert L Barker	Method and systems to control municipal solid waste density and higher heating value for improved waste-to-energy boiler operation
EP0787948A1 *	Nov 15, 1996	Aug 6, 1997	Esys-Montenay	Plant for the treatment of waste such as municipal or domestic waste
US7935490	Aug 2, 2006	May 3, 2011	N.V. Innogenetics	Immunodiagnostic assays using reducing agents

* Cited by examiner

CLASSIFICATIONS

International Classification	B09B5/00, B09B3/00, F23J15/00, F23G5/00, F23L15/04, F23J1/00, F23G5/02, F23G5/46, F23J15/02
Cooperative Classification	F23G2201/603, Y02E20/12, F23J15/02, F23G2201/80, F23G2205/125, F23J2217/102, F23J2217/101, F23G5/006, F23G2900/50214, F23G5/46, F23G2206/203, F23J2215/10, F23G2203/105, F23J2215/20, F23J2219/50, F23G2205/16, F23G5/02, F23G2205/14
European Classification	F23J15/02, F23G5/00P, F23G5/02, F23G5/46

LEGAL EVENTS

European Classification F23J15/02, F23G5/00P, F23G5/02, F23G5/46

LEGAL EVENTS

Date	Code	Event	Description
Nov 7, 2001	WWG		**Ref document number:** 1994922448 **Country of ref document:** EP
Feb 23, 1998	NENP		**Ref country code:** CA
Apr 10, 1997	REG		**Ref country code:** DE **Ref legal event code:** 8642
Mar 19, 1997	WWP		**Ref document number:** 1994922448 **Country of ref document:** EP
Jan 4, 1997	WWE		**Ref document number:** 1994922448 **Country of ref document:** EP
Apr 17, 1996	121		
Mar 14, 1996	DFPE		
Jan 4, 1996	AK		**Kind code of ref document:** A1 **Designated state(s):** AM AT AU BB BG BR BY CA CH CN CZ DE DK ES FI GB GE HU JP KG KP KR KZ LK LU LV MD MG MN MW NL NO NZ PL PT RO RU SD SE SI SK TJ TT UA UZ VN
Jan 4, 1996	AL		**Kind code of ref document:** A1 **Designated state(s):** AT BE CH DE DK ES FR GB GR IE IT LU MC NL PT SE BF BJ CF CG CI CM GA GN ML MR NE SN TD TG

Esta incorpora la 4,917,733

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Mixture of fly ash and kilm dust

US 4917733 A

ABSTRACT

A pozzolanic mixture for stablizing landfill leachate which includes fly ash with an excess of lime, kiln dust, and optionally bottom ash, which is combined with the landfill leachate with a makeup quantity of water to produce a stable cementitious pozzolanic mixture that hardens to a mortar-like material. The hardened material exhibits favorable handling characteristics, and resists leaching of its environmentally hazardous components

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Fee status	Lapsed
Also published as	CA2009512A1, CA2009512C
Inventors	David L. Hansen
Original Assignee	Hansen David L
Export Citation	BiBTeX, EndNote, RefMan

Patent Citations (18), Referenced by (21), Classifications (12), Legal Events (9)

External Links: USPTO, USPTO Assignment, Espacenet

IMAGES (7)

DESCRIPTION

BACKGROUND OF THE INVENTION

I. Field of the invention

This invention relates to pozzolanic mixtures for the stabilization and disposal of landfill leachate

II. Background of the Related Art

Landfill leachate contains toxic and other water soluble contaminants from residential and commercial waste disposal. Landfill leachate also contains non-aqueous contaminants suspended or mixed with the water soluble contaminants. Leachate can percolate through the subsoil of the landfill and contaminate the water supply of surrounding communities.

Kiln dust is a fine powdery waste product often derived from the manufacture of portland cement in cement kilns. Kiln dust is difficult to handle at disposal facilities and can not be reused in wet process cement processing plants.

The solid wastes collected from residential and commercial sources can be used as fuel in power boilers or incinerators. The burning of this waste produces fly ash, a fine airborne particulate commonly collected from the product of the combustion stream using smoke stack scrubbers with electrostatic precipitators, baghouses and other conventional smoke stack scrubbing operations. Often fly ash may contain a certain amount of excess lime which is added during the dry scrubbing process. The burning of waste also leaves a solid residue in the form of granular, random-size free flowing bottom ash, which remains in the bottom of the incinerators or power boilers after combustion is complete

CLAIMS (20)

I claim:

1. A pozzolanic mixture for stabilizing landfill leachate, comprising: fly ash, kiln dust, and landfill leachate which is cured to form a solid, leach-resistant body.

2. The mixture recited in claim 1, wherein the mixture further comprises bottom ash.

3. The mixture recited in claim 1, wherein said fly ash includes excess lime added during a scrubbing process.

4. The mixture recited in claim 1, wherein said components include:

(a) fly ash in a concentration from about 15% to 45% by weight of said mixture,

(b) kiln dust in a concentration from about 15% to 45% by weight of said mixture, and,

(c) landfill leachate in a concentration from about 15% to 40% by weight of said mixture.

5. The mixture recited in claim 4, wherein said fly ash includes added lime in the range of about 2% to 8% by weight.

6. The mixture recited in claim 5, further comprising up to 50% by weight bottom ash.

7. The mixture recited in claim 6, wherein said remainder quantity of landfill leachate is made up from water.

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Both bottom ash and fly ash contain toxic metals and other materials which by themselves present environmental and health hazards. Fly ash typically contains lead, chromium and cadmium, along with other hazardous metals. Bottom ash often contains lead, ferrous metals, chromium and cadmium. Typically, landfill leachate contains various organic compounds, biological contaminants, suspended petroleum products, mercury, and other hazardous metals.

The non-metallic components in bottom ash are suitable for use as a lightweight aggregate substitute in making concrete and like products in the construction industry. Thus, there are significant economic advantages to be derived from the recovery of the granular bottom ash materials from the incineration residue. In addition, the non-metallic recoverables of bottom ash can be used to dilute the environmentally hazardous fly ash for disposal in landfill operations. Methods for recovery of useful materials from refuse bottom ash are disclosed in U.S. Pat. No. 4,669,397, the contents of which are incorporated herein by reference.

U.S. Pat. Nos. 4,274,880 and 4,226,630 disclose means for disposing of hazardous liquid wastes in combination with fly ash. Neither of these references discloses or suggests the use of kiln dust, fly ash and the optional inclusion of bottom ash for the disposal of hazardous liquids. In addition, neither of these patents disclose or suggest that such a cementitious mixture may be combined to dispose of landfill leachate. Specifically, U.S. Pat. No. 4,226,630 is directed towards the disposal of water-borne heavy metal sludge produced in metal processing and refining plants, by combining the sludge with a very specific type of fly ash formed through the combustion of sub-bituminous coal which is only mined in the "Powder River Basin" of Gillette, Wyoming.

U.S. Pat. No. 4,375,986 discloses the combination of waste water which has a

8. The mixture recited in claim 7, wherein said components include

(a) fly ash about 17.6% by weight

(b) kiln dust about 17.6% by weight

(c) landfill leachate about 17.6% by weight; and

(d) bottom ash about 47.2% by weight

9. The mixture recited in claim 7, wherein said components include

(a) fly ash about 11.7% by weight

(b) kiln dust about 23.6% by weight

(c) landfill leachate about 17.6% by weight; and

(d) bottom ash about 47.1% by weight

10. The mixture recited in claim 7, wherein said components include

(a) fly ash about 44% by weight;

(b) kiln dust about 22% by weight;

(c) landfill leachate 34% about by weight; and,

(d) no bottom ash

11. A method for the disposal of landfill leachate comprising the steps of: combining fly ash, kiln dust and landfill leachate to form a pozzolanic mixture, and curing the mixture to form a solid leach-resistant body

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type of fly ash formed through the combustion of sub-bituminous coal which is only mined in the "Powder River Basin" of Gillette, Wyoming.

U.S. Pat. No. 4,375,986 discloses the combination of waste water which has a pH not greater than 2, fly ash, and lime ($Ca(OH)_2$), Portland cement, "ground blast furnace slag", or slag cement. However, it does not disclose nor suggest the novel combination of landfill leachate, fly ash and kiln dust to form a pozzolanic mixture.

U.S. Pat. No. 4,028,130 is directed towards the disposal of digested sewage sludge by combining it with lime or its equivalent of lime dust or cement kiln dust, with fly ash and sufficient water. The disposal of landfill leachate is nowhere taught nor suggested in U.S. Pat. No. 4,028,130.

U.S. Pat. No. 4,101,332 reissued as Re 30,943 is directed towards a mixture of fly ash, cement kiln dust and water to produce a durable mass which is capable of supporting surfacing as pavement bases. There is no disclosure or suggestion in this patent for using any of these components to stabilize landfill leachate. U.S. Pat. No. 4,018,617, which was based on the same application as Re 30,943 is directed towards a mixture of fly ash or a pozzolan (to the exclusion of lime), cement kiln dust and aggregate to produce a hard, strong, durable mass for pavement-like surfacing. The disclosure does not suggest the use of such a mixture for stabilizing landfill leachate and requires a large proportion of aggregate.

U.S. Pat. No. 4,038,095 is also based on the same patent application as Re 30,943, but is directed toward a mixture or method for making a mixture for pavement bases and the like utilizing fly ash, lime stack dust and aggregate. It does not, however, disclose the use of this mixture for the stabilization of landfill leachate.

11. A method for the disposal of landfill leachate comprising the steps of: combining fly ash, kiln dust and landfill leachate to form a pozzolanic mixture, and curing the mixture to form a solid leach-resistant body.

12. The method recited in claim 11, further comprising adding bottom ash to said pozzolanic mixture.

13. The method recited in claim 11, wherein said fly ash includes excess lime which has been added during a scrubbing process.

14. The method recited in claim 11, wherein in said steps:

(a) fly ash is added in a concentration from about 15% to 45% by weight of said mixture;

(b) kiln dust is added in a concentration from about 15% to 45% by weight of said mixture; and,

(c) landfill leachate is added in a concentration from about 17% to 40% by weight of said mixture.

15. The method recited in claim 14, wherein said fly ash includes added lime in the range of about 2% to 8% by weight.

16. The method recited in claim 15, further comprising the step of adding up to 50% by weight bottom ash to said pozzolanic mixture.

17. The method recited in claim 16, further comprising the step of adding water to said pozzolanic mixture to make up for any remaining quantity of landfill leachate.

18. The method recited in claim 17, wherein in said steps:

(a) fly ash is added in a concentration of about 17.6% by weight.

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pavement bases and the like utilizing fly ash, lime stack dust and aggregate. It does not, however, disclose the use of this mixture for the stabilization of landfill leachate.

Lastly, U.S. Pat. No. 4,432,800 is directed towards the treatment of kiln dust used in pozzolanic reactions with calcium oxide, calcium hydroxide or sodium hydroxide. The treated kiln dust is used with a pozzolan such as fly ash and a filler to produce a durable mass. There is no disclosure or suggestion in U.S. Pat. No. 4,432,800 for using such a mixture for the stabilization of landfill leachate. Nor is the optional use of bottom ash disclosed.

Accordingly, the related art does not hitherto disclose or suggest any mixture or method useful for the stabilization and disposal of landfill leachate.

It is an object of this invention to provide a method and pozzolanic mixture which chemically converts to a strong, hard and durable mass with favorable handling and leaching characteristics.

Another object of this invention is to permanently stabilize hazardous materials contained in landfill leachate, as well as similarly stabilize the other hazardous components of the fly ash, kiln dust and bottom ash mixture.

SUMMARY OF THE INVENTION

In view of the need for a safe means for disposing of landfill leachate, fly ash, kiln dust and bottom ash the present invention provides a pozzolanic mixture which includes fly ash with an excess of lime, kiln dust, and optionally bottom ash, which is combined with the landfill leachate with a makeup quantity of water to produce a stable cementitious pozzolanic mixture that hardens to a mortar-like material. The hardened material exhibits favorable handling characteristics, and resists leaching of its hazardous components. For a better understanding of the present invention, reference is made the following

quantity of landfill leachate

18. The method recited in claim 17, wherein in said steps,

(a) fly ash is added in a concentration of about 17.6% by weight;

(b) kiln dust is added in a concentration of about 17.6% by weight;

(c) landfill leachate is added in a concentration of about 17.6% by weight; and,

(d) bottom ash is added in a concentration of about 47.2% by weight.

19. The method recited in claim 17, wherein in said steps,

(a) fly ash is added in a concentration of about 11.7% by weight;

(b) kiln dust is added in a concentration of about 23.6% by weight;

(c) landfill leachate is added in a concentration of about 7.6% by weight; and,

(d) bottom ash is added in a concentration of about 47.1% by weight.

20. The method recited in claim 17, wherein in said steps,

(a) fly ash is added in a concentration of about 44% by weight;

(b) kiln dust is added in a concentration of about 22% by weight;

(c) landfill leachate is added in a concentration of about 34% by weight; and,

(d) no bottom ash is added.

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water to produce a stable cementitious pozzolanic mixture that hardens to a mortar-like material. The hardened material exhibits favorable handling characteristics, and resists leaching of its hazardous components. For a better understanding of the present invention, reference is made the following

description, the scope of which is defined by the claims.

(c) landfill leachate is added in a concentration of about 34% by weight; and,

(d) no bottom ash is added.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with the present invention, a pozzolanic mixture is produced by combining lime enriched fly ash with kiln dust, landfill leachate, and optionally, bottom ash.

The appropriate ranges of these components is fly ash - from about 15% to 45% by weight; kiln dust - from about 15% to 45% by weight; landfill leachate (with a makeup quantity of water) - from about 17% to 40% by weight; and, optionally bottom ash up to about 50% by weight. A mixture of 17.6: 17.6: 17.6: and 47.2% by weight, respectfully, is preferred. Other preferred combinations include mixtures of 11.7: 23.6: 17.6 and 47.1% by weight, respectively, or 44: 22: 34: 0(no bottom ash), respectively. The preferred fly ash contains excess lime from about 2% to 8% by weight as a result of the dry scrubbing process; more preferably from about 5% to about 8% lime by weight. If, however, an insufficient quantity of lime is present in the fly ash, excess lime may be added to the mixture in order to further stabilize the pozzolanic reaction. The hydration of the lime together with the kiln dust and the naturally pozzolanic fly ash results in a mortar-like hardening of the cured material which provides a hard, strong and leach-resistant body.

Typically, landfill leachate is collected from the bottom of lined landfill cells and kept in a holding tank for disposal. Prior to disposal kiln dust and fly ash are usually maintained in silos whereas bottom ash is often stored in a bunker which acts as a surge storage mechanism. The mixture can be combined in a pugmill, a device commonly used for mixing mortar which includes a vessel with twin counter-rotating mixing shafts, which can be installed beneath the silos. If bottom ash or other aggregate is used, then the mixture can be mixed in a typical cement mixing truck. The cementitious mixture can then be transported from the pugmill to dump trailers, or to cement mixing trucks for further mixture, and driven to any desired disposal site. Once hardened by pozzolanic reaction, the cementitious mixture converts to a hard concrete-like mass which resists the leaching of its toxic components even if subsequently crushed to sand sized particles.

The United States Environmental Protection Agency (USEPA) has promulgated rules which define "Hazardous Waste".

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disposal site. Once hardened by pozzolanic reaction, the cementitious mixture converts to a hard concrete-like mass which resists the leaching of its toxic components even if subsequently crushed to sand sized particles

The United States Environmental Protection Agency (USEPA) has promulgated rules which define "Hazardous Waste". These rules specify the maximum permissible concentrations of a number of contaminants, for example, Table 1 shows the USEPA maximum permissible non-hazardous leachate concentrations of several contaminants set forth in the Federal Register, 50, (114), pages 21649-21693 (1986), and 40 C.F.R. part 261 entitled "Identification and Listing of Hazardous Waste" at Section 261.24. The concentrations referred to are in the liquid produced by a standardized leaching procedure known as the Extraction Procedure Toxicity Test (EP Tox).

TABLE 1

TABLE 1____MAXIMUM CONCENTRATION OF CONTAMINANTSFOR CHARACTERISTIC OF EP TOXICITYEPA Maximumhazardous Concentrationwaste (milligramsnumber Contaminant per liter)

____DOO4 Arsenic 5.0DOO5 Barium 100.0DOO6 Cadmium 1.0DOO7 Chromium 5.0DOO8 Lead 5.0DOO9 Mercury 0.2DO10 Selenium 1.0DO11 Silver 5.0DO12 Endrin (1,2,3,4,10,10-hexachloro-1,7- 0.02 epoxy-1,4,4a,5,6,7,8,8a-octahydro- 1,4-endo, endo-5, 8-dimethano naphthaleneDO13 Lindane (1,2,3,4,5,6-hexachlorocyclohexane, 0.4 gamma isomerDO14 Methoxyclor (1,1,1-Trichloro-2,2-bis [p- 10.0 methoxyphenyl]ethane)DO15 Toxaphene ($C_{10}H_{10}Cl_6$, Technical 0.5orinated camphene, 67-69 percent chlorine)DO16 2,4-D, (2,4-Dichlorophenoxyacetic acid) 10.0DO17 2,4,5-TP Silvex (2,4,5- 1.0 Trichlorophenoxyproprionic acid)

____

Three good indicia of toxicity in the extract from the EP Tox test are: cadmium: 1.0 mg/l maximum permissible leachate concentration allowed by the USEPA; chromium: 5.0 mg/l maximum permissible leachate concentration allowed by the EPA; and, lead 5.0 mg maximum permissible concentration allowed by the EPA.

The testing of samples described in the following examples was performed by personnel at the State University of New York at Syracuse, when using the TCLP procedure described below; and, by the Adirondack Environmental Services, Inc. in Rensselaer, New York, a state certified, independent testing laboratory which specializes in hazardous waste and petroleum product analysis, when using the EP Tox test. The two tests performed, the Extraction Procedure Toxicity Test

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Three good indicia of toxicity in the extract from the EP Tox test are: cadmium: 1.0 mg/l maximum permissible leachate concentration allowed by the USEPA; chromium: 5.0 mg/l maximum permissible leachate concentration allowed by the EPA; and, lead: 5.0 mg maximum permissible concentration allowed by the EPA.

The testing of samples described in the following examples was performed by personnel at the State University of New York at Syracuse, when using the TCLP procedure described below; and, by the Adirondack Environmental Services, Inc in Rensselaer, New York, a state certified, independent testing laboratory which specializes in hazardous waste and petroleum product analysis, when using the EP Tox test. The two tests performed, the Extraction Procedure Toxicity Test (EP Tox), and the Toxicity Characteristic Leaching Procedure (TCLP), are performed in order

"to determine whether a waste, if mismanaged, has the potential to pose a significant hazard to human health or environment due to its propensity to leach toxic compounds. The worst case scenario selected for the TCLP, as well as for the current EP Tox is co-disposal of hazardous wastes with municipal waste in a sanitary landfill." Federal Register, supra.

The greatest difference between the EP Tox and the TCLP is the extraction procedure, summarized in Table 2:

TABLE 2__________________________________ Extraction Water toTest Solvent Time Solid Ratio Monitoring__________________________________EP Tox Acetic 24 hours 16:1 ContinuousAcidTCLP Acetic 18 hours 20:1 Minimal NaOH*__________________________________ *The Extraction Solvent used depends upon the pH of the material being analyzed. See Federal Register, supra, at page 21687, Sections 7.12.3 and 7.12.4.

Other differences between the EP Tox and the TCLP include the addition of (38) organic and inorganic compounds to the list of (14) Toxicity characteristic contaminants which are tested in the EP Tox. As more chemicals are found to be hazardous to human health, the list is likely to be further expanded. In addition, the agitation apparatus used in testing has been adjusted and augmented to increase the repeatability and precision of the test between various labs and batches. Only one shaker (instead of three used in EP Tox) has been designated. This agitation device adheres to ASTM D3987. Also, to get a more precise value on volatile organics, the Zero-Headspace Extraction Vessel has been developed. This vessel allows 25 grams of waste to be analyzed without releasing most of its volatile components. This device is compatible with general laboratory equipment and is easy to handle. Other minor changes have been made to increase precision. Waste materials which adhere to the side walls of containers is accounted for and glass filters are specified in order to decrease organic contamination and facilitate drainage.

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In addition, unlike the EP Tox, which will allows the samples to remain whole, the TCLP requires all solid samples to pass through a 9.5 mm sieve, or have a surface-area-gram of material equal to a greater than 3.1 cm. Also, the TCLP addresses exhaustion of the alkalinity of a waste over a long period of leaching. Two different leachates are used depending upon the alkalinity of the waste to be tested.

Other changes not mentioned above, include: a new method of determining Chronic Toxicity Reference Levels. This "new approach uses chronic toxicity reference levels, combined with a compound specific dilution/attenuation factor, to calculate regulatory level concentrations for individual toxicants." Federal Register, supra.

EXAMPLES EXAMPLES 1 AND 2 - INITIAL LABORATORY TESTING

Initial laboratory tests of the present invention utilizing fly ash obtained from the Albany, New York Solid Waste Energy Recovery System ("ANSWERS") refuse derived fuel recovery plant, Albany, New York, mixed with cement kiln dust from two sources, New Lime/K, Reclamation Systems, Inc., Ravena, New York, and Independent Cement Corp., Catskill, New York. The dry powders were mixed with water and allowed to cure for various periods of time. The procedure includes the weighing of the specific quantities of fly ash, kiln dust and water and then mixing the ingredients in the specified proportions. Observation of the workability and physical characteristics of the mixture were then made. These samples were allowed to cure for approximately ninety (90) days. The physical appearance of the cured mass was similar to Portland Cement concrete. Samples were then crushed to a sandy particle size and subjected to both EP Tox and TCLP testing. The results of these tests are summarized on Tables 3 and 4.

TABLE 3____RESULTS OF TESTS ON ANSWERS FLY ASH AND BOTTOM ASHFOR METALS BY TCLP AND BULK ANALYSISConcentration in ppm____USEPA TCLP Samples Bulk Chemical Analysis SamplesMax Permissible mg/l mg/kgContaminant Concentration (1) (2) (3) (4) (5) (6) (7) (7) (8) (9) ____Cadmium 1.0 mg/l 0.05 0.05 0.11 0.28 0.49 * 3.30 44.87 13.63 7.02Chromium 5.0 mg/l * * * * * 0.12 * 13.00 0.00 29.00Lead 5.0 mg/l 0.30 0.30 0.45 0.75 0.87 0.23 4.40 896.60 78.35 3304.60____Description of Samples% By WeightSample # % Fly Ash % Kiln Dust % Bottom Ash % Water

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0.75 0.87 0.23 4 40 896.60 78.35
3304.60____Description of
Samples% By WeightSample # % Fly Ash % Kiln Dust % Bottom Ash % Water
Observations____(1) 17.6 17.6
47.2 17.6 Good mortar-like consistency, appears stiff but workable, water rises to top.(2) 35.7 35.7 0.0 28.6 Workable, but a bit stiff, water rises to top.(3) 11.7 23.6 47.1 17.6 Good mortar-like consistency, good workable concrete (4) 44.0 22.0 0.0 34.0 Stiff mortar, too stiff to pour out of truck, but workable(5) 23.8 0.0 59.5 16.7 Good workable mixture (6) 0.0 44.4 22.2 33.4 Soupy slurry, would flow well, but is too wet.(7) 100.0 0.0 0.0 0.0(8) 0.0 100.0 0.0 0.0(9) 0.0 0.0 100.0
0.0____*Below detection limits,
<0.01 mg/l

TABLE 4____RESULTS OF
TESTS ON ANSWERS FLY ASH AND BOTTOM ASHFOR METALS BY EP TOXICITYConcentration in
ppm____USEPA EP Toxicity
Samples Bulk Chemical Analysis SamplesMax Permissible mg/l mg/kgContaminant Concentration (1) (2) (3) (4) (5) (6) (7) (7) (8) (9)____Cadmium 1.0 mg/l
N/A 0.04 N/A 0.12 N/A N/A 2.33 44.87 13.63 7.02Chromium 5.0 mg/l N/A * N/A * N/A N/A 0.10 13.00 0.00 29.00Lead 5.0 mg/l N/A 0.19 N/A 0.22 N/A N/A 38.20 896.60 78.35
3304____Description of
SamplesSample # % Fly Ash % Kiln Dust % Bottom Ash % Water
Observations____(1) 17.6 17.6
47.2 17.6 Good mortar-like consistency, appears stiff but workable, water rises to top.(2) 35.7 35.7 0.0 28.6 Workable, a bit stiff, water rises to top.(3) 11.7 23.6 47.1 17.6 Good mortar-like consistency, good workable concrete.(4) 44.0 22.0 0.0 34.0 Stiff mortar, too stiff to pour out of truck, but workable.(5) 23.8 0.0 59.5 16.7 Good workable mixture.(6) 0.0 44.4 22.2 33.4 Soupy slurry, would flow well, but it is too wet.(7) 100.0 0.0 0.0 0.0(8) 0.0 100.0 0.0 0.0(9) 0.0 0.0 100.0
0.0____*Below detection limits,
<0.05 mg/l (N/A samples (1), (3), (5) and (6) were not tested by EP Tox.)

EXAMPLES 3 AND 4 - INCORPORATING LANDFILL LEACHATE

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<0.05 mg/l (N/A samples (1), (3), (5) and (6) were not tested by EP Tox.)

EXAMPLES 3 AND 4 - INCORPORATING LANDFILL LEACHATE

Additional samples were prepared as described in Examples and 1 and 2, but instead of water these samples utilized landfill leachate from a Plainville, Massachusetts landfill. Some of the samples were placed into an extractor within thirty (30) minutes of mixing, simulating the performance of the materials at the time of landfill placement. The results of the EP Tox tests for these samples (1A-1D) are shown in Table 5. Other samples were allowed to cure for seventeen (17) days, and then crushed to a powder and extracted. The results of EP Tox tests for these samples (2A-2D) are shown in Table 6.

TABLE 5____RESULTS OF
TESTS ON STABILIZED PLAINVILLE LEACHATE ANDANSWERS FLY ASH FOR METALS BY EP TOXICITY30 Minute MixConcentration in
ppm____USEPA EP Toxicity
Samples Bulk Chemical Analysis SamplesMax Permissible mg/l mg/kgContaminant Concentration (1A) (1B) (1C) (1D) (5) (5) (6) (7) (8)____Cadmium 1.0
mg/l 0.17 0.18 0.11 0.13 2.33 44.87 13.63 0.06 <0.04Chromium 5.0 mg/l * * * * 0.10 13.00 0.00 0.23 0.13Lead 5.0 mg/l 0.45 0.48 0.24 0.29 38.20 896.60 78.35 1.09
0.33____Description of
SamplesSample # % Fly Ash % Kiln Dust % Old Leachate % New
Leachate____(1A) 34 34 0 32(1B)
34 34 32 0(1C) 44 22 0 34(1D) 44 22 34 0(5) 100.0 0 0 0(6) 0 100.0 0 0(7) 0 0 100 0(8) 0 0 0
100____*Below detection limits,
<0.05 mg/l

TABLE 6____RESULTS OF
TESTS ON STABILIZED PLAINVILLE LEACHATE ANDANSWERS FLY ASH FOR METALS BY EP TOXICITY17 Day CureConcentration in
ppm____USEPA EP Toxicity
Samples Bulk Chemical Analysis SamplesMax Permissible mg/l mg/kgContaminant Concentration (2A) (2B) (2C) (2D) (5) (5) (6) (7) (8)____Cadmium 1.0

CureConcentration in ppm_____ USEPA EP Toxicity Samples Bulk Chemical Analysis SamplesMax Permissible mg/l mg/kgContaminant Concentration (2A) (2B) (2C) (2D) (5) (5) (6) (7) (8)_____ Cadmium 1.0 mg/l * * * 0.05 2.33 44.87 13.63 0.06 <0 04Chromium 5.0 mg/l * * * * 0.10 13.00 0.00 0.23 0.13Lead 5.0 mg/l <0.10 <0.10 <0 10 0.10 38.20 896.60 78.35 1.09 0 33_____ Description of Samples% By WeightSample # % Fly Ash Kiln Dust % Old Leachate New Leachate_____ (2A) 34 34 0 32(2B) 34 34 32 0(2C) 44 22 0 34(2D) 44 22 34 0(5) 100.0 0 0 0(6) 0 100 0 0 0(7) 0 0 100 0(8) 0 0 0 100_____ *Below detection limits. <0 05 mg/l

When mixed all samples (i e samples 1A-1D and 2A-2D) had a good mortar-like consistency which appeared slightly stiff but workable. The samples were not very fluid, however, a film of water rose to the top after the mixture settled for about thirty minutes.

Lead, cadmium and chromium are normally the metals of concern in fly ash and leachate extracts. Significant reductions in the leachability of these metals on the order of one and two orders of magnitude were observed. Thus, the data in Tables 3-6 indicates that the present invention produces very positive reductions in leachability of these metals even before the mixture is fully cured.

Full Scale Demonstration Equipment

A full scale demonstration of the present invention employed a mobile, self-contained silo/mixer unit known as an ARAN ASR-280B manufactured in Australia by ARAN Mfg. Corp. This diesel powered unit is capable of storing up to 50 tons of kiln dust in a dust controlled silo and mixing the kiln dust in a pugmill with fly ash and leachate in controlled ratios. A rubber belt conveyor with a clam shell discharge loads the covered dump trailers for transit to the landfill.

Procedure

The fly ash/kiln dust mixture is collected by air pollution control equipment at the SEMASS waste to energy-facility in

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belt conveyor with a clam shell discharge loads the covered dump trailers for transit to the landfill.

Procedure

The fly ash/kiln dust mixture is collected by air pollution control equipment at the SEMASS waste to energy-facility in Rochester, Massachussets, and stored in a silo. The fly ash flows by gravity discharge into either of two pugmills located above a drive-thru discharge zone. The fly ash is conditioned to any desired moisture content prior to gravity discharge into the ARAN "aggregate" hopper which is positioned in the drive-thru below the fly ash discharge.

Cement kiln dust is metered onto a belt carrying the fly ash product to the mixer. Leachate and any makeup amount of water is also be added prior to the ARAN pugmill. The ARAN unit provides 2500 gallons of leachate/water storage.

The three components are intimately mixed in the pugmill and then discharged onto a rubber belt conveyor for trailer loading.

The preferred physical consistency of the finished mix is a moist silty texture, but not saturated. This mixture is not free-flowing like toothpaste or wet mortar, but rather is like a moist soil. At the landfill, a compactor immediately travels over the mixture. Some eight to ten days after compaction, the mixture hardens to a concrete like durability.

An important aspect of the full scale demonstration is the determination of the final mix ratios. The preliminary experiments, discussed above, indicate that ratios of fly ash/kiln dust/leachate of 2:1:1.7 are appropriate. Lower concentrations of kiln dust may be appropriate, however, when the fly ash contains higher concentrations of lime.

Landfill Handling During The Full Scale Demonstration

The stabilized mixture is transported in leakproof, covered dump trailers to a lined landfill facility. The stabilized mixture is dumped in the dedicated ash disposal cell. When any bottom ash is utilized, the stabilized mixture is combined with the appropriate ratio of bottom ash (up to 50%). In either case, the mixture is immediately compacted and covered with soil daily. No special handling is required.

Thus, while I have described what are presently the preferred embodiments of the present invention, other and further changes and modifications could be made thereto without departing from the scope of the invention, and it is intended by the inventor herein to claim all such changes and modifications.

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Thus, while I have described what are presently the preferred embodiments of the present invention, other and further changes and modifications could be made thereto without departing from the scope of the invention, and it is intended by the inventor herein to claim all such changes and modifications.

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				Co-combustion of waste sludge

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				Device and processing for treatment of concentrated

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WO2011015889A2 *	Jul 12, 2010	Feb 10, 2011	Milli Spanovic	Device and processing for treatment of concentrated solutions originating from drained waste waters in communal and industrial waste

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CLASSIFICATIONS

U.S. Classification	106/707, 106/710
International Classification	C04B28/22, C04B28/02, C02F11/00
Cooperative Classification	C04B2111/00784, C04B28/021, C02F11/008, C04B28/18
European Classification	C02F11/00F, C04B28/02B, C04B28/22B

LEGAL EVENTS

Date	Code	Event	Description
Mar 11, 2011	AS	Assignment	**Effective date:** 20110307 **Owner name:** LSC ENVIRONMENTAL PRODUCTS, LLC, NEW YORK **Free format text:** MERGER;ASSIGNOR:LANDFILL SERVICE CORPORATION;REEL/FRAME:025940/0860
Mar 9, 2011	AS	Assignment	**Free format text:** NUNC PRO TUNC ASSIGNMENT:ASSIGNOR:LANDFILL TECHNOLOGIES, INC.;REEL/FRAME:025924/0802 **Effective date:** 20110307 **Owner name:** LANDFILL SERVICE CORPORATION, NEW YORK

WO1996000365A1	Jun 23, 1994	Jan 4, 1996	Energy Answers Corp	products and energy from refuse waste
WO2011015889A2 *	Jul 12, 2010	Feb 10, 2011	Milli Spanovic	Device and processing for treatment of concentrated solutions originating from drained waste waters in communal and industrial waste

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European Classification	C02F11/00F, C04B28/02B, C04B28/22B

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