SLUDGE INCINERATION pdf

1: WasteWater System: Wastewater Sludge Incineration Technologies

Incineration is a safe way of turning a problem waste into an opportunity. Mechanically dewatered sludge cannot be incinerated auto thermally, i.e. reaching a temperature above Â°C without the use of auxiliary fuel.

Biosolids " Biosolids " is a term often used in wastewater engineering publications and public relations efforts by local water authorities when they want to put the focus on reuse of sewage sludge , after the sludge has undergone suitable treatment processes. In fact, biosolids are defined as organic wastewater solids that can be reused after stabilization processes such as anaerobic digestion and composting. Thickening is often the first step in a sludge treatment process. Sludge from primary or secondary clarifiers may be stirred often after addition of clarifying agents to form larger, more rapidly settling aggregates. Thickeners often resemble a clarifier with the addition of a stirring mechanism. Dewatering[edit] Schematic of a belt filter press to dewater sewage sludge. Filtrate is extracted initially by gravity, then by squeezing the cloth through rollers. Centrifugation may be a preliminary step to reduce sludge volume for subsequent filtration or evaporation. Filtration may occur through underdrains in a sand drying bed or as a separate mechanical process in a belt filter press. Filtrate and centrate are typically returned to the sewage treatment process. After dewatering sludge may be handled as a solid containing 50 to 75 percent water. Dewatered sludges with higher moisture content are usually handled as liquids. This liquid requires further treatment as it is high in nitrogen and phosphorus, particularly if the sludge has been anaerobically digested. The treatment can take place in the sewage treatment plant itself by recycling the liquid to the start of the treatment process or as a separate process. Phosphorus recovery[edit] One method for treating sludge dewatering streams is by using a process that is also used for phosphorus recovery. Another benefit for sewage treatment plant operators of treating sludge dewatering streams for phosphorus recovery is that it reduces the formation of obstructive struvite scale in pipes, pumps and valves. Such obstructions can be a maintenance headache particularly for biological nutrient removal plants where the phosphorus content in the sewage sludge is elevated. For example, the Canadian company Ostara Nutrient Recovery Technologies is marketing a process based on controlled chemical precipitation of phosphorus in a fluidized bed reactor that recovers struvite in the form of crystalline pellets from sludge dewatering streams. The resulting crystalline product is sold to the agriculture, turf and ornamental plants sectors as fertiliser under the registered trade name "Crystal Green". The most common treatment options include anaerobic digestion , aerobic digestion, and composting. Anaerobic digestion Anaerobic digestion is a bacterial process that is carried out in the absence of oxygen. Though allowing shorter retention time and thus smaller tanks , thermophilic digestion is more expensive in terms of energy consumption for heating the sludge. Mesophilic anaerobic digestion MAD is also a common method for treating sludge produced at sewage treatment plants. The sludge is fed into large tanks and held for a minimum of 12 days to allow the digestion process to perform the four stages necessary to digest the sludge. These are hydrolysis, acidogenesis, acetogenesis, and methanogenesis. In this process the complex proteins and sugars are broken down to form more simple compounds such as water, carbon dioxide, and methane. Methane generation is a key advantage of the anaerobic process. Its key disadvantage is the long time required for the process up to 30 days and the high capital cost. Sufficient energy can be generated in this way to produce more electricity than the machines require. Aerobic digestion Aerobic digestion is a bacterial process occurring in the presence of oxygen resembling a continuation of the activated sludge process. Under aerobic conditions, bacteria rapidly consume organic matter and convert it into carbon dioxide. Once there is a lack of organic matter, bacteria die and are used as food by other bacteria. This stage of the process is known as endogenous respiration. Solids reduction occurs in this phase. Because the aerobic digestion occurs much faster than anaerobic digestion, the capital costs of aerobic digestion are lower. However, the operating costs are characteristically much greater for aerobic digestion because of energy used by the blowers, pumps and motors needed to add oxygen to the process. However, recent technological advances include non-electric aerated filter systems that use natural air currents for the aeration instead of electrically operated machinery. Aerobic digestion can also be achieved by using diffuser systems or jet aerators to oxidize the sludge. Fine bubble diffusers are typically the more cost-efficient diffusion method, however, plugging is typically a problem due to sediment settling into the smaller air holes. Coarse bubble diffusers are more commonly used in activated sludge tanks or in the flocculation stages. A key component for selecting diffuser type is to ensure it will produce the required oxygen transfer rate. Aerated static pile composting Composting is an aerobic process of mixing sewage sludge with agricultural byproduct sources of carbon such as sawdust, straw or wood chips. In the presence of oxygen, bacteria digesting both the sewage sludge and the plant material generate heat to kill disease-causing microorganisms and parasites. Stiff materials like corn cobs, nut shells, shredded tree-pruning waste, or bark from lumber or paper mills better separate sludge for ventilation than softer leaves and lawn clippings. Initial moisture content of the composting mixture should be about 50 percent; but temperatures may be inadequate for pathogen reduction where wet sludge or precipitation raises compost moisture content above 60 percent. Composting mixtures may be piled on concrete pads with built-in air ducts to be covered by a layer of unmixed bulking agents. Odors may be minimized by using an aerating blower drawing vacuum through the composting pile via the underlying ducts and exhausting through a filtering pile of previously composted sludge to be replaced when moisture content reaches 70 percent. Liquid accumulating in the underdrain ducting may be returned to the sewage treatment plant; and composting pads may be roofed to provide better moisture content control. The optimum initial carbon-to-nitrogen ratio of a composting mixture is between Sewage sludge after drying in a sludge drying bed. Sludge incineration Incineration of sludge is less common because of air emissions concerns and the supplemental fuel typically natural gas or fuel oil required to burn the low calorific value sludge and vaporize residual water. Co-firing in municipal waste-to-energy plants is occasionally done, this option being less expensive assuming the facilities already exist for solid waste and there is no need for auxiliary fuel. Drying beds[edit] Simple sludge drying beds are used in many countries, particularly in developing countries, as they are a cheap and simple method to dry sewage sludge. Drainage water must be captured; drying beds are sometimes covered but usually left uncovered. Mechanical devices to turn over the sludge in the initial stages of the drying process are also available on the market. Drying beds are typically composed of four layers consisting of gravel and sand. The first layer is coarse gravel that is 15 to 20 centimeters thick. Followed by fine gravel that is 10 centimeters thick. The third layer is sand that can be between 10 to 15 centimeters and serves as the filter between the sludge and gravel. Sludge dries up and water percolates to the first layer that is collected at the drainage pipe that is beneath all layers. Phosphorus recovery from sewage sludge or from sludge dewatering streams is receiving increased attention particularly in Sweden, Germany and Canada, as phosphorus is a limited resource a concept also known as " peak phosphorus " and is needed as fertilizer to feed a growing world population. This combined action sterilizes the sludge and makes it more biodegradable, which improves digestion performance. Sterilization destroys pathogens in the sludge resulting in it exceeding the stringent requirements for land application agriculture. Processes for reducing water content include lagooning in drying beds to produce a cake that can be applied to land or incinerated; pressing , where sludge is mechanically filtered, often through cloth screens to produce a firm cake; and centrifugation where the sludge is thickened by centrifugally separating the solid and liquid. Sludges can be disposed of by liquid injection to land or by disposal in a landfill. There is no process which completely eliminates the need to dispose of treated sewage sludge. Much sludge originating from commercial or industrial areas is contaminated with toxic materials that are released into the sewers from the industrial processes. In New York City , for example, several sewage treatment plants have dewatering facilities that use large centrifuges along with the addition of chemicals such as polymer to further remove liquid from the sludge. The product which is left is called "cake," and that is picked up by companies which turn it into fertilizer pellets. This product, also called biosolid, is then sold to local farmers and turf farms as a soil amendment or fertilizer, reducing the amount of space required to dispose of sludge in landfills. This reduces the required size of interceptor sewers and allows local recycling of treated wastewater while retaining the economy of a single sludge processing facility and is an example of how sewage sludge can help solve an energy crisis. This has led some to claim that the term "biosolids" was created by the sewage treatment industry in order to take the focus off the origins of the material to make reuse more acceptable to the public, and some studies have suggested that this is in fact a form of propaganda.

2: Sludge incineration facilityï¼œJFE Engineering Corporation

Sludge incineration (German: KlÃ¤rschlammverbrennung, Chinese: æ±¡æ³¥ç„šçƒ§å•‘ç”µ) is a sewage sludge treatment process using www.enganchecubano.com generates thermal energy from sewage sludge produced in sewage treatment plants.

With two newly installed steam boilers and one steam turbine, it is generating at least 95 percent of its power requirements from the waste heat of the incineration process itself. Operating costs have been reduced by nearly 10 percent. Until now, the plant only generated low-pressure steam from the waste heat. The steam is used in various processes and, to a limited extent, for power generation. Boiler specialist NEM, owned by Siemens and operating under its own brand, has now replaced two of the four low-pressure steam boilers with high-pressure boilers and has installed a turbine that generates electricity via a generator. This makes it possible for the operator to use the exhaust heat much more efficiently and produce nine times more power than before. Recovering Raw Materials Enlarge image The location for the new boiler. Part of the roof is taken off so the boiler can be hoisted into place. In Germany alone, about eight million tons of dewatered sewage sludge accumulates every year. Around one third of the sludge is used for agriculture, a share that has stagnated for years due to the increased quality requirements for sewage sludge. Incineration is therefore becoming increasingly attractive, either in specialized plants or as additional fuel in cement plants, coal-fired power plants, and waste incineration plants. Dedicated plants that only incinerate sewage sludge offer the advantage that valuable raw materials contained in the sludge, particularly phosphorous, can be separated and reused as fertilizers. In the Netherlands, N. Slibverwerking Noord-Brabant SNB operates this type of dedicated plant and processes approximately , tons of dewatered sewage sludge every year. The dried sludge is incinerated at a temperature of approximately degrees Celsius. Waste heat is used more efficiently and phosphorous is recovered as fertilizer Customized Boiler Enlarge image Picture from the roof top. The boiler is ready to be placed. When the SNB plant was retrofitted with two high-pressure steam boilers for power generation, engineers from boiler specialist NEM, which became part of Siemens in , faced two challenges. They had to design the boilers so they could fit into the plant, which was built in In addition, the boilers had to be installed as quickly as possible while the plant was in partial operation so as not to disrupt processing of sewage sludge. Experts implemented a boiler that meets the specifications for the turbine degrees Celsius steam temperature at a pressure of 60 bar while also complying with prescribed restrictions for size and weight. In addition, it was necessary to adjust the spacing of pipes in accordance with height restriction while at the same time taking into account the fouling characteristics of the fuel. Engineers had to pay special attention to the selection of steam temperature. Sewage sludge contains many different chemical elements, some of which corrode metal at very high temperatures. The steam drives a Siemens SST industrial steam turbine. The turbine has two modules connected in parallel. A high-pressure module is operated at a steam pressure of 60 bar. After this, a low-pressure module supplies the remaining steam in the form of process steam at a pressure of 2. This low-pressure steam is used primarily to dry the sewage sludge, which contains approximately 75 percent water upon delivery. Retrofitting with high-pressure boilers eliminated the steam motor operated with low-pressure steam that had previously been used to generate electricity with a kilowatt generator. Instead, the plant now uses a 3.

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3: On-site incineration of sewage sludge - HUBER SE

sludge incineration - Thermylisâ„¢ Fluidized bed thermal process at atmospheric pressure to destroy organic matters. The Thermylis TM transforms sludge into a mineral product that is not harmful and that can be recycled.

Where are we now? In January we asked them to fix the flaws in the Biosolids Study see below ; they said they had an internal document. Current 20 yr contracts expire in They might be able to tell us how much revenue Synagro receives for burning all outside sludge in New Haven. They have a contractual agreement with Synagro that allows Synagro to incinerate sludge in New Haven. He states that he has no interest in phasing out the sludge contracts. They released their report in April It became final in April See links to New Haven Independent coverage of this time. The Yale Environmental Protection Clinic reports: At worst, it is biased and inaccurate and totally devoid of public input. Does not address pollutants from the smokestack and does not factor into conclusions. Initial draft called for public input, final report deleted public input. Weighing criteria does not allow for relative importance. Incorporates costs into evaluation of benefits wrongly penalizing alternatives. Double counts energy recovery giving advantage to incineration. Measuring performance of alternatives was not transparent, impossible to evaluate. Scoring of alternatives not transparent and highly questionable on their face. Use erroneous figure for average amount of regional sludge incinerated undermining subsequent calculations. Overestimates the amount of sludge that will be processed under the status quo. The use of this inflated estimate leads to a number of significant mistakes in the report. The report uses an erroneous figure for the quantity of FOG wastes thereby further underestimating the amount of non-regional sludge incinerated by the status quo Estimated number of truck deliveries under the status quo do not match the CHNWPCA records thereby underestimating the reduction in traffic and truck emissions that would result from ending non-regional sludge incineration.

4: Sludge Incineration - HUBER SE

1/95 Solid Waste Disposal Sewage Sludge Incineration There are approximately sewage sludge incineration (SSI) plants in operation in the United.

In this position Leon also contributed to a large number of studies on treatment options for sewage sludge by STOWA , the Dutch institute for applied water research of the waterboards. This page gives a short introduction to treatment options for sewage sludge. Origin Sewage sludge is the semi solid residue left from the treatment of waste water. In a waste water treatment plant the sewage sludge helps to degrade the organic pollutants in the waste water through the microbiological activity in the sewage sludge. The sludge will also act as an adsorbent for a wide range of pollutants that are not readily degraded through microbiological processes. During the treatment of the waste water the amount of sludge in the plant grows and therefore part of the sludge has to be discharged. This waste material can be treated in many different ways. The different treatment options will be discussed below. Digestion Especially at larger water treatment plants the waste sludge is normally first digested in a sludge digester to produce biogas from the sludge. This biogas can then be used in a gasmotor to produce electricity and heat. In some configurations the water treatment plant can even produce a net surplus. In the last years several processes have been developed to improve the digestibility of the sludge by means of a pre-treatment of the sludge. The most popular and effective means seems to be a thermal hydrolysis of the sludge. Dewatering After digestion, the sludge is dewatered as far as possible by mechanical means. Typically with dewatering centrifuges or belt filter presses, but sometimes also with chamber filter presses or screw presses. In other countries, like for instance Germany, the sludge dewaters better and better dewatering results can be achieved. Generally the dewatering results are better with digested sludge. Apparently sludge from biological phosphorous removing plants dewaters worse than other sludges, but this still has to be proven with a serious survey. Final treatment options The most popular disposal route of the sewage sludge has always been the application of the sludge as a fertilizer in agriculture. In a way this is logical as the sludge contains a lot of nitrogen and phosphorous and these are valuable nutrients. Also the organic matter in the sludge can improve the agricultural value of the soils to which it is applied. On the down side the sludge contains a lot of pollutants like pathogens, heavy metals and persistent organic contaminants. Therefore not always all stakeholders are pleased with this application. Also, if the sludge is brought to soils without any control of the nutrient balance this method can contribute to eutrophication of surface waters. Therefore agricultural application of sewage sludge is often controlled in many countries by a lot of legislation and is banned in other countries. Most probably agricultural application is best suitable for rural situations where the treated wastewater is not very polluted and where there is a real need for nutrients in agriculture. If agricultural application is not possible or not wanted other disposal routes have to be considered. Landfilling of sewage sludge is not very often applied because the high water content requires special measures. In some special applications the sludge can be mixed with binding agents and ashes to produce a hardened product that can be used as a covering layer for landfills Hydrostab. The most widely used disposal route for sewage sludge is incineration. Incineration reduces the volume of the sludge with a factor 10 and will destroy any organic pollutants in the sludge. If the sewage sludge is incinerated in a dedicated incinerator the sewage sludge ash can potentially be used as raw material for phosphate recovery. For mono-incineration of sludge typically bubbling fluidized beds are used that have proven to be very reliable. Waste heat from the incinerator can be used for the drying of the sludge. Modern incinerators should also be able to generate their own electricity so that the sludge can be treated in an energy-neutral manner. Treatment of the flue gas from the incinerator is necessary to remove pollutants like NO_x, SO_2, HCl and mercury from the flue gas. Normally no dioxins are produced if the incinerator is well designed and therefore the incinerator is a net-destructor of dioxins, since the treated sludge will normally already contain a certain concentration of dioxins. Special attention should also be paid to the formation of laughing gas, N_2O, during the incineration. A good design of the incinerator and operating conditions can minimize the formation of this greenhouse gas. An alternative to the mono-incineration of sewage sludge is co-incineration of the sludge in municipal solid waste incinerators

MSWI , coal fired power plants or cement kilns. Coal fired power plants can also co-incinerate dewatered sludge. Especially brown coal power plants are suitable as these plants already use a low quality fuel source. In the Netherlands also composting of the sewage sludge is used as a measure to increase the heating value of the sludge to make co-incineration in a power plant easier. Co-incineration of sewage sludge in a coal fired power station will make a better use of the energy content of the sludge when compared to mono-incineration, but the down side is that the flue gas treatment of a power station is not designed to handle the flue gas from waste materials. For sewage sludge especially the emission of mercury from the sludge is an issue that should be considered. For co-incineration of sewage sludge in cement kilns it is necessary to completely dry the sludge in special sludge driers. Preferably the drying should take place with waste heat to ensure a positive energy balance. Several drying systems have been developed for sewage sludge over time and experiences have shown that specially designed systems are required to cope with the specific difficulties of sewage sludge. A mayor disadvantage of all co-incineration options is the fact that the phosphate from the sewage sludge is lost though dilution of the sludge with other waste materials. Visit this website for more information on the importance of phosphate recycling. New developments In the last years the focus of sewage sludge treatment has been to find the best way to get rid of a waste material. Over time more attention has been given to energy optimization and this has resulted in the treatment options that have been described above. At this moment there is an increasing awareness that we should see waste materials like sewage sludge as a resource, while carefully controlling the pollutants in the sludge. With this focus new treatment methods are being developed. Sewage sludge can for instance be an important source of nutrients like nitrogen, phosphorous and sulfur. Especially the recovery of phosphorous is becoming more and more important and can be an important driver for the development of new technologies. Recent developments make it possible to recover the phosphorous from sewage sludge ash, thus favoring the mono-incineration of sewage sludge. New technologies like supercritical oxidation of gasification of sewage sludge could potentially lead to new methods to recover these nutrients from sewage sludge. The organic content could also be a raw material for a biobased economy. Other options can be steps like the supercritical hydrolysis of sewage sludge to sugar molecules. These sugars could then also be fermented to produce lower alcohols like ethanol or butanol that can be important base-chemicals for green chemistry. These processes are currently being tested on lab or pilot scale and still need a lot of development. Nevertheless there seems to be a lot of potential for radical new methods of sludge treatment methods.

5: Sludge incineration - Wikipedia

Sludge incineration generates heat and power in sufficient quantities for sludge dryer operation. Both sludge drying and incineration should be done side by side. Our advanced sludge2energy concept offers operators of wastewater treatment plants a complete chain of sludge treatment, including sludge incineration.

On-site incineration of sewage sludge Flow diagram of the sludge2energy Solution Landfilling and land application of sewage sludge is no longer permitted in some countries and incineration remains the only viable method for sludge disposal. Sludge is commonly incinerated in large central plants or, as an additive, in coal fired power stations or in cement kilns. We offer another option: Sludge incineration at the treatment plant provides the following advantages: Hot dryer air is drawn by blowers through the slowly moving belts and the sludge layer thereon. The hot dryer air absorbs water and is thus cooled. Most of the air is re-circulated and blended with a smaller flow of preheated ambient air. Some of the dryer air is drawn by another blower out of the dryer thus keeping the entire dryer at a slight under-pressure to prevent dryer air, odour and vapour from escaping. This exhaust air is cooled in a heat exchanger whereby the extracted heat is used for preheating the incoming atmospheric air. Vapour condenses in the heat exchanger and the water is returned to the treatment plant. The exhaust air is further cooled and cleaned in a scrubber. The hot flue gas flows through a pebble heat recuperator that transfers heat to compressed ambient air. The hot and compressed air drives a micro gas turbine and a generator. Because of direct gas-to-air heat transfer no water-vapour cycle is required. The pebble heat recuperator consists of a pair of vessels that are filled with pebbles. Hot flue gas and compressed atmospheric air are blown sequentially through the vessels. At the same time, in the other vessel, the pebbles are cooled and transfer their heat to the compressed atmospheric air. When the temperature difference between the flue gas and the air exceeds a certain level, the gas and air flows are switched to the other vessels. The air is then cooled in a heat exchanger whereby the heat is recovered to pre-heat ambient air entering the sludge dryer. Alternatively, some water can be injected and evaporated, thus cooling the compressed air and increasing the flow. Its now much larger volumetric flow drives the micro-turbine whereby it expands further while its pressure drops. The still warm air is blown as combustion air into the sludge furnace. Formation of nitroxides is prevented by staged combustion, flue gas recirculation and selective non-catalytic reduction. The flue gas, after it has been cooled and screened in the pebble recuperator, enters a further gas cleaning system. Acidic gases, such as SO2 and HCl are neutralized and removed by addition of lime to the exhaust gas. Remaining organic components, such as dioxins and furans, as well as volatile heavy metals are removed through adsorption on activated carbon. Fly ash and other particles are finally removed with filter elements. It is coated with an inorganic material to guarantee long life and low flow resistance. The exhaust meets the stringent German requirements. This first plant will have a capacity to incinerate 2, tons of sludge dried solids per year and will generate kW of electrical power.

6: Biosolids Technology Fact Sheet Use of Incineration for Biosolids Managementd

Sludge Incineration Using a proven thermal technology known as "fluidized bed" incineration, the STF treats sewage sludge through ultra-high temperature combustion. This advanced technique suspends the sludge in a hot bubbling bed of sand, through which jets of air are blown to mix the sludge with sand rapidly and to provide the oxygen.

National Technical Information Service U. Therefore, publication of this report at this time is for information purposes only and does not reflect the views and policies of the Environmental Protection Agency. Multiple-hearth and fluidized bed furnaces, containing scrubbing devices for particulate removal, were selected for performance evaluation. The sludge, particulate, stack gas, scrubbing liquid, and ash were sampled, and analyzed for heavy metals, pesticides and oxides of nitrogen and sulfur. The results indicated that incinerators are capable of achieving low emission concentrations for the common pollutants. Particulate samples showed a measurable concentration of lead. The ash samples normally showed a higher concentration of the heavy metals when compared with the sludge samples, however, mercury was one of the exceptions and was not detectable in the ash sample and assumed as lost to the stack gases. The pesticides and PCB, present in the sludge, were not detectable in either the ash or the scrubbing water, and indicated complete destruction. The study demonstrated that well designed and operated municipal sewage sludge incinerators can meet the most stringent existing particulate emission control regulation. This was true for both fluidized bed and multiple hearth type incinerators. Most sludge incinerators which are in existence today, however, do not incorporate high efficiency particulate matter control devices. Small, but measurable, quantities of specific metals which are known to accumulate in the human system, and which are known to be toxic at certain levels, were found in the input sludge, stack emissions, scrubber water, and residue of those incinerators which were subjected to compre- hensive testing under Task Force supervision. These same metals were also found in each instance where only the sludge alone was analyzed. Small, but measurable, quantities of specific organic chemical compounds including various pesticides and polychlorinated biphenyls, which are known to accumulate in the human system, were found In all of the sludge samples analyzed. It should be expected that, under conditions of poor combustion, such compounds could be emitted from the stacks of sewage sludge incinerators. It was impossible for the Task Force to accurately establish the potential for health effects which might be associated with sewage sludge incineration because: There are insufficient health effects data relating to low atmospheric concentrations of suspected pollutant materials including certain elements such as Cadmium, Arsenic, Beryllium, Nickel, Copper, Lead Chromium, Vanadium, and Mercury, Organic Pesticides, and Poly- chlorinated Biphenyls. There are insufficient stack gas sampling and analysis methods sophisticated enough to produce accurate information regarding the quantity, size distribution, and constituent quality related to size, of the particulate matter emitted by sewage sludge incinerators. Such is the case concerning the ultimate disposal of sludge from sewage treatment plants. Primary sewage treatment is designed to remove the bulk of the solids present in the sewage. The removed solids, in the form of sludge, are s either disposed of directly from the primary process or receive their final disposal after combination with sludges from secondary treatment processes. In certain areas, particularly on the East Coast, the practice has been to barge sewage sludge to sea, for ultimate disposal into the ocean depths. It is this form of disposal which has, over the past year, been the subject of official concern and action because of its apparent adverse affect upon life on the ocean floor. In October , the Council on Environmental Quality recommended, in its "Ocean Dumping - A National Policy", that ocean dumping of sludge should be phased out as an ultimate disposal practice. The State of New Jersey has taken strong legal steps to curtail sludge dumping at sea and, at last count in September , 39 House of Representatives and 4 Senate bills, to restrict ocean dumping, were under consideration by Congress. If, as appears likely, unrestricted disposal at sea will not continue to be an acceptable practice for sludge removed in sewage treatment plant operations, what alternatives exist? In order to give searching considera- tion to this question, the Environmental Protection Agency established two separate task forces in the spring of Each task force included representation from all fields of environmental control, with special involvement from the Office of Water Programs, Office of Air Programs, and the Office of Research and Monitoring. The second Task Force was charged with the responsibility of determining whether or not the sludge incineration alternative is acceptable at this time. This question is immediately important because incineration will become the likely choice for sludge disposal by communities presently barging their sludge to sea if ocean dumping is prohibited outright. Incineration of sludge, of course, has an inherent potential for air pollution; it is this potential which has dominated the thinking of the Environmental Protection Agency Sewage Sludge Incineration Task Force. To provide information upon which answers to the basic questions could be formulated, the following Task Force program was established: Develop data regarding emissions into the atmosphere from existing sewage sludge incinerators. Qualitative and quantitative information would be gathered from a variety of incinerator types handling a variety of sludge types. Develop data regarding potential emissions into the atmosphere, based upon analyses of sewage sludge content entering existing incinerators. The analyses would be made for major pollutant materials of concern, with special emphasis upon health-effects-related pollutants. Examine characteristics of incinerated sludge residue to provide in- formation for ultimate disposal of the ash. Review anticipated technology involving combustion processes for sludge, in order to make recommendations for pilot plant efforts which go beyond existing incinerator types. It was decided by the Task Force that sampling analyses at existing incinerator sites should include the major metals and such materials as PCB Polychlorinated Byphenyls as well as the more common air pollutants. This decision was made because of the importance that must be given to health-effects-related compounds. As the Task Force study program got underway, 16 existing sludge incinerators across the country received preliminary investigation. Of these 16, 5 were of the fluidized bed type and 11 were multiple hearth incinerators. All of the incinerators incorporated scrubbing devices for control of particulate matter. As a result of this initial examination, 3 incinerators were chosen for detailed sampling and analysis. The Barstow incinerator input included only raw sludge from primary treatment; this installation utilized the fluidized bed principle. The South Lake Tahoe unit burned both sludge from the primary process and residue, from an activated sludge unit; a multiple hearth incinerator was used. The Lorton, Virginia incinerator was also multiple hearth; it 5 handled primary sludge and grease. A summary of the information which has resulted from the sampling program conducted at the three sites can be given as follows: Sulfur oxides, again, were measured only at the California sites; measured concentrations did not exceed 13 ppm as an average emission during the test period. These test results indicate that well designed and operated sludge incinerators are able to achieve acceptably low emission concentrations for the common pollutants. It should be stated here, however, that the three test incinerators handled essentially domestic residential sewage loads. Stack Gas Analyses for Major Metals Measurable concentrations of metals were found in the stack gas material collected from both California sites. Measurable emissions on a mass per unit time basis included. Such an emission, to laymen, may seem inconsequential on an absolute basis, but lead and other elements such as cadmium, chromium, copper, nickel, and vanadium are said by Environmental Protection Agency physicians to be biologically non- degradable and toxic at certain concentrations in human tissue. All of these metals were measured in the particulate matter analyses. The elements cadmium, beryllium, nickel, copper, lead, chromium, vanadium, and mercury are said by physicians to be toxic and accumulate in the human body; all, with exception of beryllium, nickel, and vanadium were found in input sludge analyses made at Barstow, South Lake Tahoe, and Lorton. Vanadium was found only at Barstow. In addition, analyses were made for major pesticides in the input sludge at the 3 incinerator locations. At Lorton, measur- able concentrations of all of the above were uncovered. Analyses of Incinerator Ash For South Lake Tahoe, Barstow, and Lorton, metal analyses were also made of the ash remaining after incineration of the sewage sludge. The data showed that all of the mercury in the sludge is apparently lost in the stack gases, and that lead compounds are apparently carried off in the fly ash. A comparison of sludge ash composition with a coal fly ash Showed the sludge ash to have concentrations of copper, zinc, chromium and lead one or two orders of magnitude higher than coal fly ash. No" pesticide or PCB materials were found in the ash or scrubber water. It was the opinion of the Office of Research and Monitoring solid waste representative on the Task Force that ash resulting from the incineration of sewage sludge would constitute no significant threat to the environment if ultimate disposal of the ash was by acceptable sanitary landfill practice as outlined by

"Sanitary Landfill Design and Operation", a United States Environmental Protection Agency report. Because of the importance which was given to the measured presence of various metals found in samples taken at South Lake Tahoe, Barstow, and Lorton, sludge samples were taken at additional sewage treatment plants, and analyzed for metals content. The New Jersey plants included units with significant industrial inputs. Quantitative results of these tests, however, were available only in raw data form When this report was written and are included as an appendix item. Based upon relationships developed during the comprehensive sampling program carried out 3. The Monterey plant was also tested for stack effluents. The following material provides basic information with regard to this program. Background The plant survey and test program of sewage sludge incinerators was undertaken for two purposes: To survey a number of existing sludge incinerators selected from a list of installations supplied to the Office of Air Programs by the leading contractors who design and build incinerators. Based on a plant survey, a number of plants that demonstrated best emission control technology would be tested to obtain quantitative and qualitative analyses of emissions from these sources. This information in conjunction with other data would subsequently be used as a datum plane for the establishment of performance standards limiting the emissions to levels consistent with the current state of the art of control technology. To satisfy the EPA Sludge Disposal Task Force requirements to identify time urgent problems in current and imminent sludge incineration activity. Since the use of incinerators as a means of disposing of sewage sludge is increasing, there is an urgent need to determine if this is a viable disposal method as far as its total environmental impact is concerned. Phase I involved inspection visits to sixteen existing incinerators that were reported to be capable of consistently meeting the most stringent particulate emission limitations 0. Based on this inspection survey, three giants which incinerate primarily residential sludge were selected for testing to provide preliminary data to the Environmental Protection Agency Sludge Incineration Task Force. The samples were sent to the Taft Wateir Research. Center for analyses with particular emphasis on heavy metals. An additional fourteen incinerator sites were visited during Phase II. Only one of these plants, the N. Bergen plant at Waldwick, New Jersey, was deemed to be adequately controlled and suitable for testing. Particulate emissions measured during the State agency test ranged from 0. Details Source tests have been completed on four of the five incinerators selected for study. Samples of the sewage sludge residue ash , and stack gas were collected and sent to the Ultimate Disposal Section, Office of Water Programs, Cincinnati, Ohio, for chemical analysis with particular emphasis on heavy metals. The air samples were collected and analyzed by the source test con- tractor, York Research Corporation. The analysis was for NOX and S02 con- centrations and particulate grain loading. All of the sewage treatment plants that have been source tested by the Office of Air Programs, have been plants that incinerate municipal or residential type sludge. To obtain data to aid the EPA Task Force in evaluating the environmental impact of sludge incinerators that burn a high percentage of industrial waste, a program was instituted by the OWP Ultimate Disposal Section. Sludge samples were collected from a number of plants that treat industrial waste and analyzed to determine composition and heavy metal content. Preliminary analyses of industrial type sludge indicates that the heavy metals found in industrial waste are basically the same as in residential waste, varying only in concentration. Using the sludge feed and stack emission analytical data collected from tests of residential type sludge incinerators, heavy metal concentrations in the stack gas of industrial sludge incinerators can be calculated when the concentration of a particular heavy metal in the sludge feed is known. Conclusions Based on the survey and tests of existing well-controlled municipal sewage sludge incinerators: It has been adequately demonstrated that existing well-designed and operated municipal sewage sludge incinerators are capable of meeting the most stringent particulate emission control regulation existing in any State or local control agency. Most incinerators that have been built in recent years are designed for greater throughputs than required for present municipality populations. Many operate either on a partial workweek, at reduced feed rates or both. Therefore, a practical air pollution emission standard for municipal sludge incinerators should be based on operation at less than percent of design capacity. Sly single cross flow perforated plate type impinjet scrubber.

7: sludge incineration â€“ Thermylisâ„¢ - DegremontÂ®

learn about the NSPS and emission guidelines for sewage sludge incineration units, by reading the rule history, rule history, fact sheets, compliance information and additional resources.

Incineration of wastewater solids takes place in two steps. The first is drying the solids, so that their temperature is raised to the point that water in the solids evaporates. The second step is the actual combustion of the volatile fraction of the solids. Combustion can only take place after sufficient water is removed. Wastewater solids are dewatered to between 15 to 35 percent solids prior to incineration. The incineration process then converts biosolids into inert ash. Sixty-five to 75 percent of the solids are combustible, and thus the volume of ash is significantly lower than that of the original biosolids. This ash can be used or disposed of more readily due to its low volume and inert nature. If solids are dewatered to approximately 30 percent solids and their heat value is sufficient, the process can be self-sustaining, and supplemental fuel is not required to sustain combustion. Nonetheless, supplemental fuel is always needed during initial start-up operations and periodically throughout operations to accommodate fluctuation in feed solids characteristics. Ash generated by incineration of wastewater solids is usually landfilled, but some facilities use other innovative methods to reuse the ash, including: Daily landfill cover must be pelletized first. Ingredient in footing at athletic facilities, including baseball diamonds, and equestrian facilities, such as race tracks and arenas. Two types of incineration systems are commonly used for wastewater solids combustion - multiple hearth furnaces MHFs and fluidized bed furnaces FBFs. Both use high temperatures to thermally process the solids in the presence of air. Because FBFs are generally better at meeting federal emission standards, most new installations use this technology. The following paragraphs describe the two systems in greater detail. Multiple Hearth Furnace Technology The multiple hearth technology has historically been the most common system used for wastewater solids incineration. MHF systems may be operated continuously or intermittently; however, the costs and energy requirements for start-up and standby are high, making continuous operation preferable. The furnace consists of a refractory-lined, circular steel shell with several shelves or hearths and a central, rotating hollow cast iron shaft from which arms extend. Solids are fed onto the top hearth and raked slowly to the center in a spiral path. Ash is cooled on the bottom zone prior to discharge. Solids burning on the hearth release heat and generate a flow of hot gases that rise countercurrent to incoming solids. This countercurrent flow of air and solids is reused to optimize combustion efficiency - while most of the exhaust air is discharged through the hollow central shaft, a portion is piped to the lowest hearth where it is further heated by the hot ash and used to dry the incoming solids. Discharged air is sent through a scrubber to remove fly ash, and is then processed further to meet air permit requirements. Conveyors or pneumatic equipment move the ash either into temporary on-site storage or directly into trucks for transport off- site. A typical MHF has 5 to 12 hearths, is 1. Nine hearths are generally required Cooling Air Discharge for complete combustion of wastewater solids that contain 75 to 80 percent moisture. Figure 1 shows a cross section of a typical MHF. Fluidized Bed Furnace Technology Most wastewater solids incineration installations over the past 20 years have been FBFs, which are more efficient, more stable, and easier to operate than are MHFs. The bottom layer is an inert granular material usually sand that is kept in fluid condition during operation by an upflow of air. The sand bed, typically between 0. Solids are fed through nozzles into the fluidized sand bed, where solids and heated sands mix. It is here that liquid is evaporated from the solids and the volatile fraction of the solids burns. The overall combustion process occurs in the bed and in the freeboard area while the resulting ash and water vapor are carried out through the top of the furnace. A cyclonic wet scrubber is used to remove ash from the exhaust gases, after which it is separated from the scrubber water in a cyclone separator. Alternately, some plants use lagoons for long-term storage of wet ash and periodically dredge the solids from the lagoon. Plants with limited space use mechanical dewatering equipment, such as a multiclone or bag house, in combination with gas cooling equipment. Figure 2 shows a cross section of a typical FBF, which is 2. Air Pollution Control Equipment Air pollution control is an integral part of any incineration facility. Equipment must be able to control particulate emissions, gases [such as nitrogen oxides NOX , sulfur oxides SOX and carbon monoxide

CO], and other characteristics such as opacity. Particulates Particulates, including trace metals, can be controlled through use of mechanical collectors, wet scrubbers, fabric filters, and electrostatic precipitators. Mechanical collectors have a relatively low control efficiency and usually provide only partial control in a total particulate emissions control system. Mechanical collectors include settling chambers, which use gravity to induce particle settlement; impingement separators, which cause particles to lose momentum and drop out of the gas; and cyclone separators, in which the incinerator exit gas is forced down a cone of decreasing diameter. Wet scrubbers are commonly used to remove particulate matter and water soluble air contaminants such as hydrogen chloride, sulfur dioxide, and ammonia. There are several types, but the Venturi scrubber is the most widely used. Fabric filters, or bag houses, pass the incinerator exhaust gas through a series of fabric filters. These can achieve removal efficiencies of 99 percent of particles at submicro sizes. Electrostatic precipitators negatively charge particles which are then attracted to positively charged plates. Electrostatic precipitators can be wet or dry. Wet systems contain a washing mechanism and generally achieve better removal efficiencies. Electrostatic precipitators are most effective when used in combination with mechanical collectors. Efficiencies of 99 percent or greater can be achieved WEF, a. Gases The emission of problematic gases can be reduced by controlling production of these gases. The formation of NOX can be reduced through process adjustments such as operating the burners with low excess air, staging the combustion process, recirculating flue gas, and using low-NOx burners which limit the exposure of fuel to oxygen in the combustion zone. Reducing agents such as ammonia and urea can also be used to limit NOX emissions. Reduction of SOX emissions can be accomplished through use of wet or dry scrubbers. The higher temperatures destroy odorous compounds and hydrocarbons, which helps to meet emission standards WEF, Afterburners can be used on MHFs to raise exhaust gases to sufficient temperatures to destroy these problematic compounds. The need for afterburners on MHFs to reduce air emissions often gives FBFs an economic advantage in comparing the technologies for specific applications. The technology is most applicable when landfill tipping fees are high, distances to alternative disposal or beneficial use sites are long, space at the treatment plant is limited and on-site treatment of solids is desired, or beneficial use options are not appropriate. The composition and characteristics of wastewater solids are important when considering incineration. Standards regulate the metals content of incinerated solids. In addition, moisture content greatly impacts energy supplemental fuel usage. Incineration is most economical when solids are dewatered to more than 25 percent solids. Usually, the larger the quantity of solids incinerated, the greater the economies of scale i. Many incinerators even receive wastewater solids from other plants to improve the economics of the facility. Changes in wastewater constituents or solids processing may impact the potential for energy recovery. It is generally preferable to burn raw rather than digested material due to heat values. Because this incineration is less efficient, these facilities require more auxiliary fuel and have additional capital and annual operation and maintenance costs associated with the digestion process. Generation of stable material. Ash is a stable, sterile material, effectively eliminating storage and handling problems. In most cases, annual operating costs depend on fuel costs. Incinerators experience significant down time for routine maintenance and therefore require redundancy, backup, or storage. High technology instrumentation is required to comply with air pollution control permits. Modern incineration facilities generally do not present a significant health risk to the community if they are equipped with adequately maintained process control and air pollution control equipment and are operated by trained employees. An important goal of 40 CFRPart, SubpartEisto provide assurance that air pollution impacts are reduced to the maximum extent possible. More suitable for intermittent operation. Allows feed variability and reduces chance of thermal shock. The total amount of solids to be processed, including the average hourly, daily, monthly and peak amounts, must be known. The specific characteristics of the feed solids, including moisture content, percent volatile solids, heat value, and concentration of specific inorganics, must also be known. Based on this information, a heat balance can be developed using the proj ected characteristics of the feed solids. In addition to the furnace, the major physical components of an incineration system include: Supplemental fuel storage and availability. Incineration systems are designed to handle a specific range in solids volume and characteristics as determined through the mass balance and heat balance performed in designing a system. Provisions for temporary holding and storage help to even out the solids flow to the furnace. Feed volume should be maintained within the design range to ensure efficient operations. Incineration systems can handle routine fluctuations in solids characteristics, but fluctuations outside the established acceptable range may necessitate operational changes, such as increasing the amount of auxiliary fuel necessary to continue combustion. Applicability of Windboxes FBF systems can be designed to use air which is either preheated or at ambient temperature. With ambient air cold windbox technology , no preprocessing of the air fed to the furnace is performed. This step serves to increase thermal efficiencies, and reduces fuel costs by about 60 percent. However, the addition of preheating equipment may increase system capital costs by as much as 15 percent Bruner, An economic evaluation will determine the most cost effective option for a particular facility. Currently, approximately incinerators for wastewater solids are operating in the United States. These facilities process an estimated , Mg , tons per year Dominak, Eleven of these replaced existing multiple hearth facilities. Wastewater solids incinerators are regulated under Section of the Clean Air Act Amendments CAAA , which require incinerators classified as a major source of emissions those that could emit 9 Mg [10 tons] or more per year of any of identified pollutants or 23 Mg [25 tons] or more per year of any combination of the pollutants to meet technology-based standards. Incinerators that do not meet the definition as a major emissions source are still regulated for emission of 30 selected pollutants, including alkylated lead compounds, polycyclic organic matter, hexachlorobenzene, mercury, polychlorinated biphenyls, dioxins, and furans. Specific regulatory limits for wastewater solids incinerators are as follows:

8: Sewage Sludge Incineration

Normally incineration can help to further reduce and concentrate the solid content after the sludge thickening process and dewatering happened in the earlier processes have reduced the moisture level to below 30%.

9: Sludge drying and incineration

INCINERATING SEWAGE SLUDGE AND PRODUCING REUSABLE ASH: JAPANESE EXPERIENCE TAKESHIOKUFUJI Takuma Co. Ltd. Osaka, Japan ABSTRACT A municipal sewage sludge incineration system conÂ-.

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