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INCINERATOR OPERATIONS*

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Summary

Chemical Waste Management, Inc. is presently operating an 120 MBtu/h incinerator in Chicago, Illinois, three 14-18 MBtu/h fixed hearth incinerators in Sauget, Illinois, which is across the river from St. Louis. In addition, Chemical Waste Management has completed construction on a 50 MBtu/h rotary kiln incinerator at Sauget and construction is underway for a 150 MBtu/h (158 GJ/h) rotary kiln at Port Arthur, Texas.

Based on the experience of operating one of these incinerators and permitting all of them, this paper highlights some of the operational concerns

Incinerator operations can be separated into three functions. The blending and feeding of the wastes, the operation of the incinerator and the removal and disposal of ash and other residues. The breakdown of any of these functions means the incinerator is not going to operate.

This requires the waste to be understood and properly prepared before feeding to reduce operational upset. The incinerator has to be permitted to its limits and then properly maintained. The ash and residue have to be collected and disposed of in accordance to the new U.S. Environmental Protection Agency (EPA) rules and interpretations. This is not as easy as in the past. The people that operate the incinerator have to be trained. However, the incineration operation is not an exact science. The better the experience and training, the better the operation.

Introduction

Incineration is the most rapidly growing disposal method. There are a number of reasons for this growth. First, it reduces the liability in comparison to the landfill. Second, the incinerator process reduces the toxicity and volume of the waste. This means the ash and other residues that go to the landfill have less of a liability. Third, the greatest impact is the rules and regulations that greatly reduce the types of waste that can go to a landfill.

However, even with the increased emphasis on incineration all can be lost if the public does not believe we can operate the incinerator properly or if the regulatory people place unreasonable restrictions in the permit that will not allow the operator to compete in the open market with the on-site and off-site treatment processes.

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Background

In order to set the stage for the discussions on incinerator operations, it is important to understand the Chemical Waste Management incinerator background. Chemical Waste Management operates a 120 MBtu/h incinerator in Chicago, Illinois. The incinerator is a fuel and liquid-waste fired refractory-lined combustion chamber designed for two seconds retention time at 90 million Btu/h at 1200°C for PCBs and 1000°C for other wastes. The stationary portion of the incinerator is 43 feed long and 14 feet 4 inches inside diameter (13×4.3 m). The chamber is lined with 9″ thick super-duty firebrick designed for 1400°C backed by 5″-thick insulating refractory. There are two waste burners and one fuel oil/waste oil auxiliary burner. The waste burners are limited to a viscosity of 100 SSU (Saybolt second universal, 20.5 mPa·s) and a feed rate of 6012 lb/h (~2700 kg/h) when burning PCBs.

The kiln incinerates solids and sludges. Solid wastes are fed to the kiln by a conveyor belt to a feed hopper and then pushed into the kiln by a ram feeder. The sludge goes through a sludge lance (chute) in the front. The kiln is driven by a 15 hp (~11 kW) varidrive motor which rotates the kiln at 0.25–1 rpm, normally it is about 0.4 rpm. The solid waste tumbles through the incineration process which takes about 1–2 hours for the ash to come out. Ash is removed through an ash door and dumped into a skip hoist for removal. It is analyzed for PCBs to ensure complete destruction. The kiln design is less than 30 MBtu/h for solids and a feed rate of less than 2910 lb/h (~1300 kg/h) for PCBs with a temperature of greater than 870°C.

Besides Chicago, Chemical Waste Management has three fixed hearth liquid injection incinerators located in Sauget, Illinois. These are 14 to 18 MBtu/h specialty incinerators. The fixed hearth allows, when required, the ability to extend the residence time for solids. The secondary chamber is fired with fuel oil to complete the combustion of gases. The oldest incinerator controls air pollution by a quench, Venturi scrubber and a scrubber water pretreatment plant. At the two newer incinerators, the first hazardous waste dry scrubber has been installed.

A 50 MBtu/h rotary kiln with dry scrubber has just been completed at Sauget and Chemical Waste Management is in the process of construction of a 150 MBtu/h rotary kiln at Port Arthur, TX with a four stage ionizing wet scrubber which is designed to meet the 0.03 gr/dscf* particulate emission limit required by the State of Texas.

Based on the experience of the present author as a general manager at the Chicago Incinerator and his being involved in the design and permitting of these incinerators, this paper highlights some of the operational concerns.

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* gr/dscf is: grains per dry standard cubic feet. Conversion factor to gr/dsm^3 is 35.3.

Operational concerns

The first fact is that the operation of an incinerator is more an art than an exact science. You cannot just take a person and expect him or her to be trained and operate the incinerator at its best. It requires experienced operators, as well as the proper training on the procedures. Considering this, there are, however, certain concepts that will allow better operations. There are three major operations to the incinerator. There is the requirement to receive, blend and feed the waste. Then there is the operation of the incinerator itself, and lastly there is the removal and disposal of the incinerator ash and the residues for the air cleaning process.

The first operation to evaluate is the actual thermal decomposition of the waste. It is this operation that most people think about when they hear the word incineration. However, it is the easiest of the three functions to operate as long as the kiln is properly fed and the ash and residue are removed properly. The operation of the incinerator is determined by the permit conditions. These are Btu/h of material feed, pounds of waste per hour, metals loading and the chlorine concentration. If the capability of the incinerator is properly described and established during the trial burn, the incinerator can be properly operated to its maximum capacity. If, however, the trial burn limits the capacity to point B or C in Fig. 1 rather than point A, then the capability of the incinerator is limited. The other way the incinerator can be limited is by the regulatory agency preparing unreasonable limitation on the specific feed systems. It is important to know what permit condition will be issued if the trail burn is successful and also what reductions will result if any conditions of the trial burn are not successful.

Once the incinerator has an operating permit, it is necessary to operate it in a way to reduce the shut down conditions. There are a number of conditions that are reflected in the typical shutdown parameters listed in Table 1. Examples of these conditions are material by-passing the flame, poor atomiza-

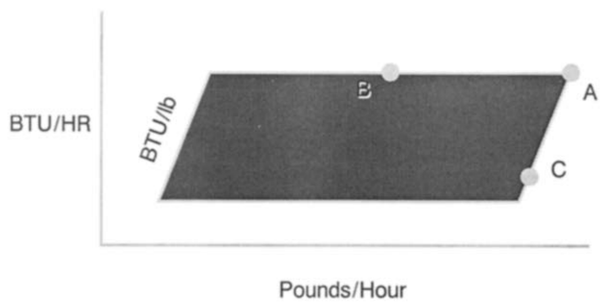

Fig. 1. General operational conditions for incinerator capability as regards limits for thermal and waste loadings (the dark area represents the range of normal operation).

TABLE 1

Typical shut-down parameters

High CO in stack
Low chamber temperature
High combustion gas flow
Low pH of scrubber water
High chamber pressure
High chamber temperature
Low burner air pressure
Low burner fuel pressure
Burner flame loss
Low oxygen

tion, poor turbulent mixing, low flame temperature, combustion reactants quenched before destruction, and volatiles release in kiln.

The way to reduce these conditions and thus reduce the shutdown is to properly blend the liquid waste before feeding to the incinerator. This requires the people at the facility to know the constituents in the waste before it arrives at the facility. In this way, one can schedule the wastes in order to make the proper blend. This is very important for facilities that have for only several weeks or less storage capacity. Once the waste has arrived, it is analyzed again to obtain the best blend. After the blending is done, the feed tank is analyzed to ensure that the results of the blend are what is expected. The same is true for solids. In addition, for solids it is very important to have no free liquids in the solid charge. The energy released by liquids in solid charges is one of the prime reasons for incinerator upset (enormous heat evolution and pressure rise).

If the proper blend has been prepared, then the feeding of the waste should cause a minimum of shutdown if the operations personnel have been trained and have developed the experience. As stated before the operation of an incinerator is an art, not an exact science. Thus, until the operators have the necessary operating experience the number of shutdowns will be higher.

The reduction of shutdowns will reduce the potential impact on the environment and human health. It also is good for business. There are 8760 hours in a year. Any hour lost to shutdown is an hour of incinerator capability lost. The average incinerator expects to operate at least 7200 hours per year. This is an on-line percentage of 82%. The goal of any good incinerator is 8100 hours or 92%. When you take away the average downtime of preventative maintenance and repair of 480 hours per year. There is only 30 minutes a day for unscheduled shutdown if the incinerator is to meet its goal of being on line 8100 hours a year. Thus, it is important to reduce shutdown to enhance the protection of the environment, but also to increase the on-line time of the incinerator.

The other operation consideration is the removal and disposal of the ash and residue. The incinerator will utilize either a wet or dry ash-removal system. In a wet system, the solid residues are dropped into a water filled quench tank. This has the drawback that any unburned organic material is quenched in the water and remains unburned.

The dry ash removal system has the ash come directly out of the incinerator into a storage container or an air cooling system and then into a container. In these cases unburnt organics continue to burn if there is oxygen.

The ash and other residues from blowdown and filter press than have to be disposed of. In a hazardous waste incinerator, they continue to be hazardous in accordance with the EPA rules. The concern now is that the August 17, 1988 Federal Register which discussed the waste to be banned from landfilling says that the waste codes carry on through and now must be on the profile sheet when the ash and residue goes to the landfill. There is also the treatment standards for the different waste codes. This requires the tracking of waste to determine the waste codes that must be placed on the profile sheet, as well as finding a landfill that is permitted to accept the waste. This now requires an expanded tracking system as the incinerator facilities. EPA is reviewing their requirements, but, however, they arrive at the final rules that ash and residue will require extra handling and tracking to be properly disposed.

Conclusions

If the role of incineration is going to expand, there is a need to operate the incinerator in accordance with the permits and regulations and to show the public that there is no increased risk.

In summary, in order to operate the incinerator we first need to have a permit that allows the incinerator to operate near its capacity. Second, we need to properly blend and package the waste feeds to reduce shutdowns and potential emissions. We also need to track the waste to know the waste codes that have to be manifested on the ash and residue in order to properly dispose of them. We also need an extensive program to track the operation personnel.