

# **APOLLO, FIRST COMMERCIAL EXPLOSIVES WASTE INCINERATOR IN THE U.S. - STATUS AND CAPABILITY**

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## **ABSTRACT**

Construction is nearing completion on the first commercial explosives waste incinerator in the U.S. designed specifically for incineration of explosives materials and items. Upon completion in September 1994, it will undergo commissioning and shakedown testing prior to trial burn testing and startup of commercial operations. The project, designated "Apollo", is being built by ICI Explosives Environmental Company, on the ICI Explosives USA plant in Joplin, Missouri. This paper presents information on the Apollo incinerator design, the project status, and the capabilities of the incinerator to burn a broad spectrum of explosive and reactive wastes, i.e., bulk pyrotechnics, explosives, and propellants (PEP), explosive devices containing a wide variety and quantity of PEP. The Apollo incinerator is based on the rotary kiln technology used successfully by the U.S. Army for many years to incinerate ammunition and explosives, but incorporates many enhancements to improve capacity, capability, and effectiveness.

## **INTRODUCTION**

Nearly all commercial explosive wastes and a majority of the military explosives wastes in the United States are currently being destroyed by open burning/open detonation (OBOD). While it can be argued that open detonation of basic explosives presents little environmental insult, the direction that demilitarization operations are moving, as demonstrated by the presentations at this symposium, is to recover such materials for reuse or recycling, rather than waste their energy by OBOD simply to get rid of them. The issue for which there is no argument is that

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OBOD of explosive materials and items containing toxic metals and other hazardous inorganic materials results in the uncontrolled release of all such hazardous elements and compounds into the environment. To minimize their environmental impact, it is essential that treatment and disposal utilize controlled incineration, coupled with proper air pollution control equipment to capture the hazardous inorganic materials. In addition, there exists a variety of items for which recycling or recovery are not practical or economically feasible.

## **BACKGROUND**

Beginning in 1988, ICI Explosives Environmental Company (ICIEEC)(formerly Atlas Powder Company and Atlas Environmental Services Inc.) recognized the need for a commercial incinerator specifically designed for disposal of waste explosive materials and items. The only such incinerators existed within the Department of Defense, and primarily within the U.S. Army. However, federal law prohibits these incinerators from accepting any explosives waste from outside of the federal government. This restriction applies not only to wastes generated by the commercial explosives industry for use in the commercial sector, but also to explosives wastes generated by commercial industry involved in the production of explosives materials and items for the U.S. military. With the increasing pressures to regulate and restrict OBOD operations, ICIEEC's parent company, ICI PLC, one of the largest explosives manufacturers in the world, made the commitment to develop a commercial explosives waste incinerator for use in disposal of wastes generated within the company that could not be reused, recycled, or converted into reusable materials. To offset the expenditure, the incinerator includes excess capacity to dispose of explosives wastes from other commercial or military sources.

## **CRITERIA FOR DESIGN**

ICIEEC's survey of incineration technology determined that the U.S. Army's Ammunition Peculiar Equipment (APE) 1236 Deactivation Furnace was the incinerator most capable of handling the wide variety of explosives materials and items requiring disposal. It was recognized that this incinerator might not be optimum for some explosives materials, but that designing the optimum incinerator for any specific material(s) would result in an incinerator with much narrower field of application. Such an incinerator would be incapable of handling the wide variety of items to be destroyed. In addition, there were no quantities of specific waste materials sufficiently large to justify the cost of permitting and building a specialized incinerator.

Building on the basic U.S. Army furnace design, ICIEEC worked with consultants and two internationally renowned engineering firms, Fluor Daniel and Foster Wheeler, to develop an enhanced and improved incinerator system. The resulting facility has improvements in health, safety and environmental protection, and throughput capacity and capability. This was achieved through the application of a modernized air pollution control system capable of meeting all current and anticipated emission limits and restrictions. Some improved features of the system are: removal of acid gases, e.g., HCl, increasing the destruction and removal efficiency (DRE) of principal organic hazardous constituents (POHC), improving the removal efficiency for heavy metals and particulates, and improving fugitive emissions control.

The Apollo plant design, operating and performance standards meet or exceed the stringent requirements of the Missouri Department of Natural Resources (MODNR) which controls issuance of permits under air, water, and RCRA Part B Hazardous Waste Incinerator regulations. It also complies with rules and regulations of the U.S. Environmental Protection Agency (EPA), the U.S. Department of Transportation, the U.S. Bureau of Alcohol, Tobacco, and Firearms, the U.S. Department of Defense, the U.S. Occupational Safety and Health Administration, the Institute of Makers of Explosives, and ISO 9000 standards (accreditation pending). Treatment, storage and disposal permits obtained to date are:

- RCRA Part B Permits from EPA and MODNR
- NPDES Operating Permit (water)
- General Operating Permit (water)
- Storm Water Permit (water)
- Construction Permit (water)
- Sanitary Waste Permit (water)
- Construction Permit (air)
- Land Disturbance Construction Permit (MODNR)

## **APOLLO PLANT DESCRIPTION**

The Apollo Plant Site contains the following:

- Field Office for direct plant support personnel, i.e., maintenance, inspection, change house support, etc.
- Storage magazines for storage of waste materials awaiting disposal.
- Storage/Feed Handling Building (SFHB) for preprocessing wastes to be incinerated. Preprocessing includes operations such as disassembly, repackaging, segregation, punching/shearing/cutting, etc.
- Unloading Area for covered movement of materials from transport vehicle into the Feed/Control Building and Car Bottom Furnace Building.
- Feed/Control Building (FCB) which houses the plant control system and from where materials are fed onto special conveyors for feeding the Rotary Kiln Incinerator.
- Car Bottom Furnace Building which houses the Car Bottom Furnace (CBF).
- Kiln Building which houses the Rotary Kiln Incinerator.
- Residual Handling Building which houses scrap metal and ash separation and collection equipment.

The Apollo Plant equipment includes:

- Rotary Kiln Incinerator (RKI), often referred to as an Explosives Waste Incinerator (EWI). This is thick walled, cast steel, cylindrical kiln with an internal spiral flight that acts as an internal auger to move materials through the kiln as it rotates. A natural gas-fired burner at the discharge end of the kiln provides the initial heat and temperature to ignite materials fed to the kiln. The heavy steel walls contain the effects of the small items that are allowed to detonate in the kiln. For items containing larger quantities of explosives, the items are preprocessed such that they will burn in the kiln rather than detonate. Exhaust gases exit the feed end of the kiln where they are pulled by suction into the Secondary Combustor or Afterburner.

- Secondary Combustor (SC) or Afterburner. The SC is a large rectangular chamber lined with ceramic fiber insulation, in which a natural gas-fired burner heats the incoming process gases from the RKI to 2200°F for destruction of organic constituents. The four seconds residence time for gases in the SC will ensure a minimum 99.99% destruction and removal efficiency of POHCs. The process gases exit the SC and enter the Spray Dryer or Scrubber.

- Spray Dryer or Scrubber. The Spray Dryer is a large cylindrical vessel with conical shaped ends into which a fine water spray interacts with the hot process gases entering the chamber. The Spray Dryer accomplishes two important processes. First, the water spray quenches the hot process gases from 2200°F to 350°F. Only that quantity of water sufficient to cool gas temperatures to 350°F is used, such that no liquid is discharged from the spray dryer. Second, soda ash mixed with the water spray reacts with acid gases such as HCl to neutralize them. Since there is no excess water, the excess soda ash and salts resulting from the acid neutralization reaction leave the spray dryer as a dry powder to be collected in the baghouse. For this reason the spray dryer is sometimes referred to as a dry scrubber.

-Baghouse. The baghouse is actually a three chamber baghouse which uses Gore-tex bags to filter out particulates from the process gas stream. As the gases pass through the bags from the outside to the inside, particulates are removed allowing only the clean gases to exit the baghouse. As an additional benefit, the excess soda ash that collects on the bags is available for neutralization of acid gases that were not reacted in the spray dryer, thereby increasing the overall efficiency of the system for acid gas neutralization. The baghouse is designed for removal of particulate down to the 0.01 grains/dscf level to ensure that the 0.03 grains/dscf limit imposed by MODNR is met. The capacity of the baghouse is such that two chambers can provide adequate particulate removal while the third chamber is being serviced.

- Induced Draft Fans. Two induced draft fans provide suction to move process gases through the system. Only one fan is normally used with the second fan acting as a backup. The fans draw the process gases from the RKI, through the SC, the Spray Dryer, the Baghouse, the fan, and then force them up and out of the 65 meter stack.

- Stack. A 65 meter stack is used to discharge the cleaned process gases into the atmosphere. A computerized continuous emissions monitoring system continuously

samples gas from the stack and measures certain air emissions to insure the system continues to operate within permit limits.

- Distributed Control System (DCS). A distributed control system which is a state-of-the-industry computerized control system centralizes control of the entire plant processes and support systems. It also collects operating data and provides historical data logs.

- Conveyor Systems. Three conveyor systems are used for material handling into and out of the RKI. There are two separate feed systems, only one of which can be used at any one time. The first is a Continuous Feed System. This system allows prepackaged materials or explosive items to be placed on a continuously moving conveyor belt which carries them from the Feed/Control Building to the Kiln Building for feeding to the RKI by means of a gravity feed chute in the RKI feed housing. The materials placed on the belt are weighed and a record of the cumulative quantity fed to the kiln is maintained. From this information, the feed rate at which materials are fed to the RKI can be verified and controlled within permit limits. The second feed system is the Positive Feed System. This system handles materials that can be loaded into boxes 7"W x 6"H x 12"L. The boxes are weighed to establish feed rate and cumulative quantity of material fed to the RKI. The boxes are conveyed to a position directly in front of the RKI where a door is opened and a ram system pushes the loaded box positively into the kiln. This system will be used primarily for bulk explosive materials. The Residual Handling System includes a metal belt conveyor which removes ash and scrap from the discharge end of the RKI, and carries it out of the Kiln Building to the Residual Handling Building. Here the ash and scrap metal is separated on a vibratory screen conveyor which then dumps the ash into metal drums, and the scrap metal into metal bins. The bins and drums are moved through the Residual Handling Building on conveyors. In addition to the other barricades around the RKI, this area is barricaded so that operators are not exposed to hot metal scrap or the potential harm that could occur in the unlikely event that items exit the RKI unexploded where they could "cook off" in the scrap metal bin. After cooling, the ash drums and scrap metal bins are removed for disposal, the scrap metal for recycling, and the ash for disposal in a hazardous waste landfill.

- Car Bottom Furnace (CBF). The CBF is a high temperature gas-fired incinerator with a mobile floor to facilitate loading of materials. The furnace will be used to pretreat materials prior to recycling, such as metal containers that may contain explosive residue. It will also be used to incinerate explosives contaminated materials such as rags, soiled uniforms, and packaging materials. The CBF will normally operate at a temperature of 1100°F. The process gases will be directed to the Secondary Combustor for further destruction of organic materials, and then to the same air pollution control system used for the RKI. The CBF and RKI will not be allowed to operate simultaneously.

- Stormwater Collection Tank. A storm water collection tank will collect rain that falls onto the air pollution control equipment pad. The water will be analyzed for contamination of explosives or heavy metals which would result in its classification as a hazardous waste. Normally the water is free of contamination and is used in the spray dryer for process water.

- Support equipment. Additional equipment is on site for support of the above described equipment. This includes an air compressor system which provides plant air and instrument air for equipment such as the baghouse, various actuators, and instruments. Also there is an emergency power generator which will provide sufficient electrical power to accomplish an orderly plant shutdown in the event of failure of the main electrical power system. The DCS is further supported by an uninterruptable power supply (UPS) that provides continuous DCS power during power outages.

- Stormwater Collection System. In addition to collection of stormwater from the air pollution control equipment pad, all storm water falling on roadways, and building aprons must be collected in a stormwater collection pond from which it can be sampled, pumped, and applied to the land application area. As a requirement of EPA, this system prevents the potential contamination of the local water from materials that originate from all impermeable surfaces by the collection and control of the water from these surfaces.

## **STATUS OF CONSTRUCTION**

Construction of the Apollo Plant at the Joplin, Missouri site began in November 1993 with excavation for roads, storage magazines, and storm water and sewer collection ponds. Throughout the winter and early spring, the building footings and foundations were being installed. Storage magazines were the first facilities constructed. All four magazines are completed at this time. Foundations, equipment pads, and buildings for the incineration facility have been completed and equipment has been installed at the time of this writing. Work remaining consists primarily of electrical and control wiring. Plant commissioning which consists of systematic equipment, subsystem, and system checkout will be conducted prior to the introduction of live explosives during shakedown testing scheduled for October through December 1994. Trial burn testing is scheduled for January 1994. Commercial operations can actually begin in October 1994 during the shakedown testing to validate actual system performance in preparation for the trial burn testing.

## **OVERALL ENVIRONMENTAL SERVICES**

As described in this paper, the first fully RCRA permitted commercial hazardous waste facility in the U.S. designed and devoted to treating a wide spectrum of explosive wastes, including explosives, pyrotechnics, propellants, munitions components, obsolete and off specification materials, and related reactive wastes will soon be available for commercial operations. However, the explosives waste disposal service offered by ICIEEC is more than just the environmentally safe incineration of waste explosives materials and items. It includes overall professional services to customers to analyze waste for reuse, recycling, or incineration. Assistance can also be provided for waste characterization, packaging, transportation, storage, inspection, and fingerprinting analysis. At ICIEEC, we believe in applying today's science for tomorrow's solutions.