



Incineration - NOT just a combustion process

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TRADEBE



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Incineration is just not Combustion



Combustion Plants

- Tend to be fueled mainly by hydrocarbons
- Very low contaminants in the fuel, usually products
- Minimal gas cleaning required
- Emission limits to air higher than incinerators

Incineration Plants,

- Fuelled by wastes, organics and inorganics present
- Extensive gas cleaning plants for inorganics removal from emissions
- Effluent treatment plants necessary
- Emission limits lowest of all thermal plants

Active waste incinerators



Discrete disposal

- Tend to be small volumes, circa 1000te pa
- Low hazard material and small packages preferred
- Activity is concentrated into the solid residues and returned to the producer,
- Particularly suited for high LLW type material

Co-Disposal Incinerators,

- Tend to be larger capacity, 8000- 250,000te pa
- May have multiple feed points for solids, liquids and gases
- Wide range of physical containers
- Activity is dispersed into the solid, aqueous and gaseous residues,
- Suitable for SoLA/VLLW/HVLLW/LLW/NORM

Co –Disposal Incinerators



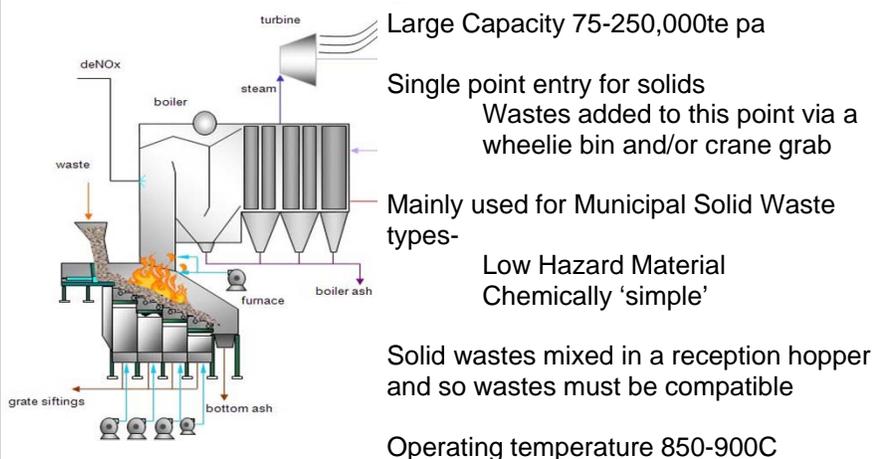
Common Legislation/Regulation *(In addition to the RSA93/EPR10),*

- All operate under Waste Incineration Directive(WID)
 - Excess Oxygen(6%), gas residence time >2s
- Gas Cleaning Plants operate to minimum standards with in WID
- Operating temperature 900-1250C
- All have to demonstrate BAT
- All have a PPC/EPR10 for incineration
- Many are top tier CoMAH sites
- Many have numerous other licences for disposing of Chemical Weapons, Controlled Drugs, Genetic Modified Organisms etc

Main Types of Co-Disposal Incinerators



Stepping/Moving Grate



Tradebe Fawley Rotary Kiln



Incinerator

Fawley Site Information



- Situated within a large petrochemical complex on an old gravel pit
- 11 acres total size of site
- 9 acres operational
- Top Tier COMAH site
- EPR permits for EPA and RSR
- Other permits include Chemical weapons, firearms, GMO, etc
- 1974 Site established
- 1990 Rotary kiln installed & solids handling systems installed
- 1994 Shredder install, replaced in 2009
- 2005 Gas Cleaning Plant upgraded

Package types



- Solids,
 - 30-205l Drums-metal, plastic, cardboard
 - Intermediate Bulk Containers(IBC)s
 - Intermediate Bulk Bags(IBBs)
 - Cardboard boxes
 - Wooden crates
 - Wheelie Bins
 - Skips
 - Iso Containers




Package types



- Liquids
 - Drums(5l-250l), metal or plastic
 - IBCs
 - Iso Tankers
 - Tankers



HTI Process Information



- Permitted Capacity
- - 45,000Tes or 100,000m³ per annum
- Thermal Capacity- 24 MW
- Co incineration of solids, liquids and gases
- Typically 85% volume reduction
- Operates under Waste Incineration Directive
- Minimum operating temperature 1100°C, typically 1200°C
- 88% availability outside of annual shutdown
- 7200 Operating hours
- Discharges to air, landfill and estuary

Thermal / Chemical Reactions



- Chemical reactions are the same whether the element is emitting radiation or not.
- Theoretical fate and partition coefficients are used for each element and therefore, each isotope.
- The process is in two key parts, thermal and chemical.
- The thermal process will combust organic materials and will also drive inorganic species to undergo reactions in the oxygen rich environment.
- This changes the matrix the radioactive isotopes are held in, either desorbing them into the gas stream or vitrifying them in the ash.
- Those in the gas stream are then quenched and chemically treated to form stable compounds.
- These compounds are then removed from the aqueous medium to form a filter cake.

HTI Process residues to landfill



- Solid vitrified ash
 - High melting point metals are bound to each other to form an inert solid
 - Each skip is internally analysed for leaching metals, TOC and Lol and a composite externally analysed. We've never had a failure on metals, any on TOC are reprocessed.
 - Disposed of at a normal non hazardous landfill as either VLLW or NORM exempt
 - 5000te sent to landfill

- Stabilised filter cake
 - Metals are in a stabilised form
 - Each skip is internally analysed for leaching metals and a composite externally tested. Never had a failure.
 - Disposed of at a normal non hazardous landfill as either VLLW or NORM exempt
 - 3500te sent to landfill



HTI Process residues cont



- Aqueous effluent,
 - Batch process with certificates of analysis
 - 24hr discharges samples retained, monthly composite externally analysed
 - Random external inspection and sampling regime by EA
 - All metals in ppb levels,

- Air emissions
 - Continuous emission monitors (CEMs) generating instant, 10min, 30min, 1hr and 24hr data
 - CEMS controls input to the incinerator
 - Monthly internal sampling
 - Annual External sampling by EA



Fawley HTI RSR EPR10



- **Overview**
 - The incineration and chemical treatment process **MUST** change the waste either physically and/or chemically and activity must be fully dispersible
 - Permit designed as a processing permit and not storage.
 - Fate of isotopes calculated on producers declaration and follows non-active elements
 - HPA undertake periodic sample of discharges and processing areas.
 - Radiological Environmental Impact Assessment revisited every 5 years or when applying for a variation
 - Permit varied 7 times over the last 5 years.
 - Increases in activities-Tritium, Carbon 14, alpha waste
 - Addition of NORM waste
 - Increase storage volume
 - Increase storage time

HTI EPR10 Accumulation Limits



- Volume: 240m³
- Time: 90 Days
- Activity:
 - Carbon-14 1.6 TBq
 - Tritium 4 TBq
 - Iodine-125, iodine-131, } 2 GBq
 - Phosphorus-32 & Sulphur-35 } 2 GBq
 - Other beta/gamma wastes 1 GBq
 - Alpha emitters 40 MBq
 - U-238, U-235, Th-232 (total) 18 MBq
 - Ra-226, Po-210, Pb-210 (each) 250 MBq
 - Ra-228, Ac-228, Th228 (each) 150 MBq

Limits are designed to keep under REPPIR limits

HTI EPR10 Disposal Limits		
▪ Volume:		No Limit
▪ Activity:		
– Carbon-14		1000 GBq/Month
– Tritium		2000 GBq/Month
– Iodine-125, iodine-131,	}	1 GBq/Month
Phosphorus-32 & Sulphur-35	}	
– Other beta/gamma wastes		500 MBq/Month
– Alpha emitters		40 MBq/Month
– NORM (per radionuclide)		2 GBq/Month
Comprehensive Conditions for Acceptance in place.		

HTI EPR10 Discharge Limits		
▪ Gaseous Discharge:		
– Carbon-14		7200 GBq/Year
– Tritium		4800 GBq/Year
– Iodine-125, iodine-131,	}	1200 MBq/Year
Phosphorus-32 & Sulphur-35	}	
– Other beta/gamma wastes		600 MBq/Year
– Alpha emitters		4.8 MBq/Year
▪ Aqueous Discharge:		
– Carbon-14		40 GBq/Month
– Tritium		2000 GBq/Month
– Iodine-125, iodine-131,	}	900 MBq/Month
Phosphorus-32 & Sulphur-35	}	
– Other beta/gamma wastes		450 MBq/Month
– Alpha emitters		500 KBq/Month
Radiological Impact Assessment is based on maximum discharges, highest dose is Carbon -14 at 20 microsieverts on most sensitive target group		

RSA93/EPR10 Case Studies



- **GLEEP- Graphite**
 - 525Te over 4 years. H-3 & C-14 desorbed. Other isotopes vitrified.
- **Sodium metal**
 - 2 batches of Sodium Coupons from NDSL & RSRL. Sodium incinerated and treated. H-3 desorbed. Other isotopes vitrified.
- **Zinc Bromide**
 - Chemically treated. H-3 discharged.
- **Chromium VI, Boron**
 - Chromium VI chemically reduced to Chromium III – precipitated from the effluent & deposited in filter cake. Boron vitrified into ash.
- **Concrete sea drums**
 - C-14 & H-3 desorbed. Concrete vitrified.
- **NORM concrete**
 - Organics burnt off. Concrete vitrified.
- **Soil**
 - Volume reduction as organic fraction combusted. H-3 / C-14 driven off.

RSA93/EPR10 Case Studies



- **Oil/solvent/grease/paint/varnish**
 - Organics combust. Isotopes discharged according to partitioning models
- **HEPA filters**
 - Shredded into drums by waste producer.
- **Ion exchange resins & desiccants**
 - Organics combust. Matrix destroyed releasing isotopes.
- **DU**
 - DU turnings in oil. Uranium vitrified in the ash.
- **CFC**
 - Freon from UKAEA. Halogens chemically treated to form stable salts. H-3 discharged.
- **Aluminium Missile tips**
 - H-3 desorbed. Aluminium melted into ash – un-recognisable.
- **Magnesium Oxide DFR**
 - Activity desorbed – DFRs unrecoverable.

RSA93/EPR10 Case Studies



- **NORM**
 - Oily wastes c/w NORM (above EO limit). Ash currently disposed to landfill under current EO
- **Putrescent Waste**
 - Organics are combusted. Mostly H-3 / C-14 contamination – discharged via stack or effluent.
- **Infectious Wastes**
 - Bio-hazard destroyed. Isotopes discharged as above.
- **Barrier wastes-PPE**
 - Volume reduction. Isotopes partitioned.
- **Cyclotron decommissioning waste**
 - Cables / soft furnishings / wood / plastic. Metal isotopes vitrified.
- **Alexander Litvinenko autopsy waste**
 - Transferred and destroyed under emergency EO. Bio-hazard destroyed. Po-210 removed via gas cleaning /ETP - disposed to landfill in filter cake

Questions

