

DESTRUCTION OF ASBESTOS CONTAINING MATERIAL AND PCB's INTO NON-REGULATED RECYCLABLES

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ABSTRACT

A patented, thermochemical technology has been developed by Asbestos Recycling Inc. (ARI) for complete mineralogical conversion of asbestos into non-asbestos. The exclusive process efficiently converts a wide spectrum of asbestos containing material (ACM) into an inert, stable, non-hazardous and non-regulated "clinker-like" end product with potential recycle value. Additionally, polychlorinated biphenyl's (PCB's) which may be associated with ACM as a secondary waste, are totally destroyed (i.e., destruction removal efficiency of 99.9999%) in compliance with EPA test protocols. The process is contained within a controlled environment aboard two transportable trailer units with worker exposures to potential contaminants measured well below OSHA Permissible Exposure Limits. A companion skid contains the afterburner and gas scrubbing equipment. A pilot process was successfully demonstrated with the Department of Energy and a full-performance demonstration project is currently under contract with the Department of Navy.

TECHNOLOGY AND PROCESS

The Asbestos Recycling Inc. (ARI) exclusive patented technology offers a thermochemical process for mineralogical conversion of asbestos containing material (ACM) to inert, stable, non-hazardous minerals with significant volume reduction of end product.

Polychlorinated biphenyl's (PCB's), associated with ACM as a secondary waste, are totally destroyed, as recently documented in a U.S. Environmental Protection Agency (US EPA) performance demonstration.

The process offers an environmentally sound, US EPA acceptable, alternative to landfill disposal with the option of end product recycling.

The ARI Process totally destroys all asbestiform mineral fibers and ACM-associated PCB's. Thus, waste-associated cradle-to-grave liabilities are terminated. A Waste volume reduction of up to 90% is achieved during the process. The inert end product has recycle potential.

In the negative pressure air containment of the ACM-PCB Destruction Mobile Unit, waste ACM and PCB materials are shredded, treated with a proprietary mineralizing agent, and heated to 2300 F for sufficient time to convert all asbestos to a "non-detect" level and completely destroy any PCB present. This has been confirmed by laboratory

analysis and documented by a Certificate of Destruction. For design and process details see (Fig.1.) General Arrangement Plan Section), and (Fig.2.) Process Flow Diagram (PFD) for the PCB ACM System, shown at the end of this paper.

DEMONSTRATION SUMMARY

Objective

The objective is to demonstrate the destruction of PCB's contained or carried in an ACM waste, converting and destroying both wastes to an inert recyclable material.

Contract

Currently under contract with the Department of Navy through the Naval Facilities Engineering Service Center (NFESC). The principal deliverable product under the contract is to clearly demonstrate the total destruction of ACM and ACM containing PCB's in the Naval industrial production environment. The demonstration is contracted for operation at Puget Sound Naval Shipyard, Bremerton, WA during 1999.

Under a former contract with the Department of Energy (Hanford site), Asbestos Recycling Inc. operated a transportable prototype asbestos conversion unit and successfully demonstrated complete destruction of ACM of various types. This demonstration revealed an opportunity to develop the technology to process radiologically contaminated ACM.

Scope

The ACM/PCB Mobile Destruction Unit can destroy a variety of ACM and PCB's from actual facility abatement and ship demolition projects at the Puget Sound Naval Shipyard, Bremerton WA.

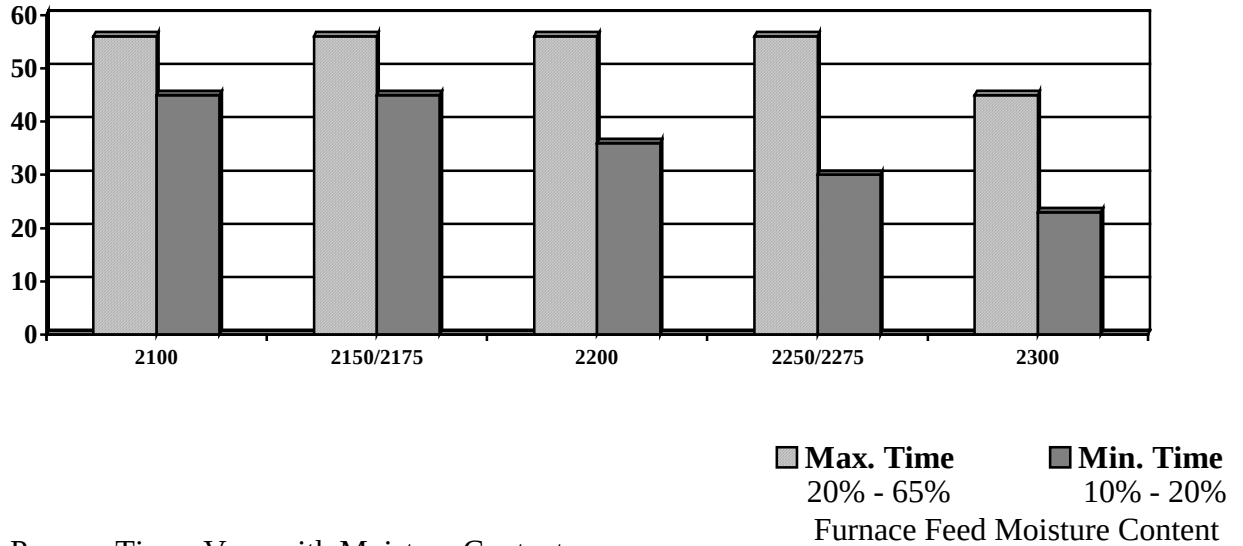
Scheduling

The ACM and ACM/PCB demonstration scheduled May 1999, will be performed under a Demonstration Plan with US EPA Office of Toxic Substances, Washington, D.C.

Permitting

US EPA's present permit allows ARI system operation with ACM nationwide as "...an alternative method of asbestos disposal pursuant to the requirements of 40 CFR 61 Subpart M, Section 152." Permitted Operating Parameters are shown on TABLE 1.0.

TABLE 1.0
PERMITTED ACM OPERATING PARAMETERS FOR ACHIEVING
NON-DETECT T.E.M. RESULTS



- Process Times Vary with Moisture Content
- Residence Time (MIN) Equals $(1/\text{RPH} \times 60) \times .75$
- Range of Feed Bed Depth: 2 Inch to 2.5 Inch
- Range of Chemical Solution: 4% to 7.5%
- Data From TEM 33 Through TEM 101

SUPPORTIVE DATA FROM DATA TABLE OF
HANFORD TESTING OPERATIONS

DATE	RESIDENCE TIME (MIN)	HEARTH TEMP (DEG. F.)	FEED DEPTH (INCHES)	HEARTH SPEED (RPH)	ADDITIVE CONCENTRATIO N (%)	TEM RESULTS (ND=NON DETECT)	TEM NUMBER
9/18/96	35	2300	2.5	1.3	6.0%	ND	81
9/19/96	35	2300	2.5	1.3	6.0%	ND	83
9/20/96	35	2300	2.5	1.3	6.0%	ND	85
9/21/96	45	2300	2.5	1.0	6.0%	ND	86
9/21/96	35	2300	2.5	1.3	6.0%	ND	87
9/23/96	35	2300	2.5	1.3	6.0%	ND	90
9/25/96	37	2300	2.5	1.2	6.0%	ND	93
5/9/96	28	2300	2.0	1.6	7.0%	ND	34
5/13/96	60	2300	2.0	0.75	7.0%	ND	35
5/14/96	45	2300	2.0	1.0	7.0%	ND	36
5/16/96	23	2300	2.0	2.0	4.5%	ND	38
5/17/96	23	2375	2.0	2.0	4.0%	ND	39

No waste stream discharges are required with normal operation. All regulated wastes are consumed in the process. Permitting allows the release of quench water to rain / sewer discharge. The system operates as a net consumer of water.

No occupational health hazards are generated during normal operation of the unit. Laboratory analyses confirm worker breathing zone air samples are in compliance with Department of Labor (OSHA) Permissible Exposure Limits (PEL's).

EPA DEMONSTRATION IN DESTRUCTION OF POLYCHLORINATED BIPHENYLS (PCB'S) AND ACM

Objective

The total destruction of PCB contaminants to a "non-detect" level will be documented with the May Demonstration. Emission test parameters for the ARI ACM/PCB conversion process are shown on TABLE 2.0. Demonstrated success of the ACM conversion system includes:

- Commercially viable, trailer mounted transportable system.
- Reusable end product produced is environmentally safe... minerals that present no environmental risk.
- Ten cubic yards of waste will occupy as little as one cubic yard after conversion.
- The volume reduction of ACM waste presents a potential technology for the reduction of radiological wastes that could save disposal space and costs.
- "Advantages include removing landfill liability, converting mineral recycle values, and eliminating the negative impact of current legislation favoring landfill ban". (Hanford Report).
- "This process should be considered because of its favorable long-term environmental attributes". (Hanford Report).

Laboratory Documentation of "Non-Detect" Destruction of ACM and PCB's

A test is planned May 1999 to demonstrate that 99.9999% of the PCB's contained in ACM is destroyed when processed by the ARI thermochemical conversion process. The US EPA approved Test Plan involves the processing of US Navy PCB/ACM waste and liquid PCB's introduced in clean ACM waste. The liquid PCB/ACM waste is being used to assure that the thermochemical conversion process can effectively handle up to 200,000 ppm, or 20% by weight of PCB's and achieve a 99.9999% destruction and removal efficiency (DRE). The Demonstration Test is being performed by Emission Technologies, Inc. of Burlington, Washington.

DRE is determined by the weight of PCB's leaving the process in the exhaust stack divided by the weight of PCB's entering the process with ACM. The weight of PCB's entering the process will be determined by analyzing typical waste entering the process.

The 99.9999% DRE Demonstration Test is successful when 1 gram or less of 1,000,000 grams of PCB's entering the thermochemical conversion process is found in the exhaust stack.

Emission Test Parameters of the EPA Demonstration Plan are shown on TABLE 2.0.

The Proposed Emission Limits of the ACM/PCB System are shown on TABLE 3.0.

TABLE 2.0 Emission Test Parameters – ARI ACM/PCB Conversion Process

Test Description	Time / Test *	No. of Tests **	Equipment & Procedures to be Used ***
Air flow	240 min	6	During Appendix A of 40CFR60, Method 5/23/CARB 428 Samples. 40CFR60 Methods 1 & 2 with 12" stack with more than 2 & 0.5 diameters ahead and behind but less than 5 and 1.25 diameters ahead and behind. For example, two (2) traverses @ 8 pts ea.= 16 traverse pts. at 15 min. each = 240 minutes. Perform with Particulate/HCl/Cl ₂ samples
Particulate/HCl /Cl ₂	240 min	6	Appendix A of 40CFR60, Method 5 condenser for HCl/Cl ₂ (i.e., Appendix A of 40CFR60, Method 26A for HCl and Cl ₂ tests) and H ₂ O test.
PCBs	240 min	6	Appendix A of 40CFR60, Method 5/23 & EPA Method 1668(mod) Procedures. Analysis per EPA Method 1668(mod) for PCBs
PDD/PCDF	240 min	6	Combined in PCB train. Method 23 for PCDD/PCDF. Analysis of the samples for both PCBs and the PCDD/PCDF. Samples will be split and analyzed separately for the PCBs and the PCDD/PCDF
SVOCs	240 min	6	Combined in PCB train. Samples will be analyzed for the PCBs, PCDD/PCDF and other SVOCs
VOCs	80 min or 160 min	6	SW-846 Method 0030 will be used to report VOCs. Four (4) pairs of tubes sampled at 20 or 40 min per pair w/three (3) pairs analyzed – fourth as QA/QC.
NO _x	240 min	6	Appendix A of 40CFR60, Method 7E
CO ₂ , O ₂ and CO	240 min	6	Appendix A of 40CFR60, Method 3A for CO ₂ and O ₂ and Method 10 for CO
Opacity	20 min	6	ETI or PSAPCA Observer, 12 observations at 20 minutes each per EPA Method 9 Procedures
* Time per test to be based on analytical detection limits for PCBs to assure that a 99.9999% removal can be demonstrated. ** One (1) run will be performed with the PSNS ACM/PCB waste as received and one (1) run will be performed with ACM spiked with PCB transformer oil (90% PCB) to produce a feedstock containing 200,000 ppm of PCBs or LPCB supplement by weight with the process			

operating at 750 lb/hr. Then, two (2) runs will be performed with the PSNS ACM/PCB waste as received and two (2) runs will be performed with ACM spiked with PCB transformer oil (90%PCB) or a LPCB supplement to produce a feedstock containing 200,000 ppm of PCBs or LPCB supplement by weight with the process operating at 900 lb/hr. Six (6) runs will be performed.

*** Sampling and analysis procedures will be performed according to tables included in the QAPP section of the Test Plan.

**TABLE 3.0 Proposed Emission Limits -
ARI ACM/PCB Conversion Process**

Parameter	PSAPCA and EPA Proposed Emission Limit
PCBs	0.001 mg/kg of PCB feed (Also 99.9999% destruction)
CO	100 ppmv @ 7% O ₂
NO _x	40 ppmv @ 7 % O ₂
HCl	100 ppmv @ 7% O ₂
Particulate	0.02 gr/dscf @7% O ₂
Opacity	Less Than 5% opacity continuously

Production

The transportable system is capable of processing up to 900 pounds per hour of asbestos containing materials (ACM).

Operation has demonstrated successful conversion/destruction of all materials processed to a non-detect level, not just the non-regulated level of less than 1% (ACM). The non-detect category requires verification by transmission electron microscopy (TEM).

The system processes a mixed variety of materials including ACM with extreme organic and moisture contents; e.g., vinyl asbestos tile (VAT) and bags of water saturated lagging.

A volume reduction of 92% has been achieved with friable ACM pipe lagging. The end product has recycling value without modification. DOE (Hanford) has used the product as low-radiological (RAD) container packing material, eliminating a previously purchased packing, and saving over \$500 per ton.

A productivity of over ten tons per day is achievable with ACM on a basis of twenty-four hour operation. Production levels involving PCB's contained within ACM are adjusted, as defined by offgas scrubbing requirements.

The US EPA required destruction removal efficiency (DRE) is achieved when 99.9999% of the PCB's entering the process are destroyed. Only 0.0001% of the PCB's entering the process may leave the process in the exhaust stack.

Materials Processed

Virtually all forms of asbestos, asbestos containing material and abatement associated wastes normally found in asbestos-related work can be processed in mixed or segregated forms.

Solid and liquid form PCB's associated with asbestos wastes in ship demolition activities can be fed at contamination levels of up to 200,000 ppm (20%) with asbestos as the waste carrier. Liquid PCB's at up to 200,000 ppm (20%) impregnated within the ACM are considered to be a solid waste form.

ACM/PCB Destruction Mobile Unit Feed Stock Includes:

1) Asbestos:

- pipe lagging - aircell, asbestoscell, magnesium silicate, silicate
- thermobestos.
- block lagging - magnesia block, thermobestos, silicate thermobestos
- asbestos contaminated soil
- asbestos transite wallboard
- asbestos papers, blankets, felts
- asbestos sponge felts
- asbestos duct tape
- asbestos coatings, cement and finishes
- asbestos floor tiles (vat)
- asbestos gasket materials
- asbestos millboard sheets
- asbestos sheetrock and tape
- asbestos cloths and woven fabrics
- asbestos asphalt products

2) Abatement Materials:

- polyethylene plastics
- duct tape
- disposable clothing
- gloves (leather, rubber, etc.)
- spray glues
- HEPA filters
- aluminum and stainless jackets
- tie wire, metal fasteners
- respirators
- lumber
- PVC piping, fittings
- rubber shoes, boots
- latex encapsulants
- surfactants/asbestos wetting agents

3) Polychlorinated Biphenyls

- wool felts
- gaskets
- oils
- paints
- wire coverings

TECHNOLOGY ACCOMPLISHMENTS

The process offers a new technology solution to the disposal and recycling of conventional and mixed hazardous asbestos wastes.

The process meets national Environmental Protection Agency (EPA) and regional regulatory requirements.

The process has been determined by EPA and Puget Sound Air Pollution Control Agency (PSAPCA) to be an alternative (to landfill) method of asbestos disposal. The Technology was featured as a "Success Story" at the 1996 Seattle White House Briefing and Conference on Environmental Technologies.

Operation for over nine months at the DOE Hanford site successfully converted 100% of ACM feed materials.

The technology was specified for volume reduction of low level radiological asbestos wastes with the Hanford reactor 105-C interim safe storage project FY97/FY98. Project timing unfortunately did not allow for the demonstration.

A Demonstration will be performed for US EPA which will permit processing of PCB contaminated ACM wastes generated from ship and submarine demolition activities at the Puget Sound Naval Shipyard.

The exclusive, patented thermochemical process converts asbestiform fibers into harmless natural minerals of a non-toxic, non-fibrous form while totally destroying PCB's impregnated in the ACM mixed waste stream.

The process destroys PCB's without generation of dioxin and furan emissions, meeting the on-going destruction removal efficiency (DRE) requirement of 99.9999 % (6-nines).

ARI TECHNOLOGY BENEFITS

- Process eliminates future liabilities associated with asbestos and PCB's.
- Allows generator site processing and remediation.
- Reduces waste volume and weight significantly.
- Reduces overall disposal expense.
- Eliminates PRP liabilities associated with landfill disposal.
- Generates an inert end product with value added recycling potential.

TECHNOLOGY APPLICATION

- Conversion of asbestos generated from abatement and remediation activities at Governmental and Commercial sites worldwide.
- Reduces asbestos waste volumes to an inert recyclable end product.
- Destroys PCB waste volumes.
- Can reduce low RAD contaminated asbestos waste volumes and storage costs significantly.
- Conversion of asbestos generated at Public Utilities:
- Some utilities have viewed the system as a service to be offered to their customers in addition to its value in disposing of in house ACM and PCB's.
- A future in processing of RAD ACM and RAD ACM/PCB wastes is promising, needing development of a regulatory demonstration at this time.
- An alternative to landfills for foreign operations has been recognized.
- Fixed and mobile systems are planned with throughput capacities of up to 50-tons per day.
- Foreign interests have included Bermuda, Canada, France, Germany, Holland, and Italy.



