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In this U.S. Bureau of Mines report, the application and impact of the Resource Conservation and Recovery Act's (RCRA) regulations on the minerals industry's efforts at resource recovery were analyzed; some major regulatory conflicts that hinder these efforts are discussed. One major conflict was the ambiguity in determining materials considered to be solid wastes under the Environmental Protection Agency's (EPA) jurisdiction. In addition, it was found that some rules have combined effectively to discourage reuse efforts and that EPA has provided only a few limited exclusions for recyclable materials. As a case study, aluminum industry spent potliner was examined to demonstrate these adverse impacts. Prior to regulation, this material was being recycled for legitimate economic and resource recovery purposes to extract its energy and fluoride values through environmentally sound processes. However, virtually all efforts to reuse the material ceased after regulation, which has resulted in increased land disposal of mineral resources and increased costs to industry. Presently, the fully utilized reuse of this material could produce estimated avoidable costs and savings for industry of about $24 million. However, this amount may greatly understate the potential savings as hazardous waste land disposal costs increase through the anticipated imposition of increased state taxation.

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RCRA's Solid Waste Regulation and Its Impact On Resource Recovery In The Minerals Industry

By

Shaun D. Peterson

UNITED STATES DEPARTMENT OF THE INTERIOR • BUREAU OF MINES

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

Btu	British thermal units	mg	milligram
L	liter		

RCRA'S SOLID WASTE REGULATION AND ITS IMPACT ON RESOURCE RECOVERY IN THE MINERALS INDUSTRY

By Shaun D. Peterson[1]

ABSTRACT

In this report, the application and impact of the Resource Conservation and Recovery Act's (RCRA) regulations on the minerals industry's efforts at resource recovery were analyzed, and some major regulatory conflicts, which hinder these efforts, discussed. One major conflict was the ambiguity in determining materials considered to be solid wastes under the Environmental Protection Agency's (EPA) jurisdiction. In addition, it was found that some rules have combined effectively to discourage reuse efforts and that EPA has provided only a few limited exclusions for recyclable materials.

As a case study, aluminum industry's spent potliner was examined to demonstrate these adverse impacts. Prior to regulation, this material was being recycled for legitimate economic and resource recovery purposes to extract its energy and fluoride values through environmentally sound processes. However, virtually all efforts to reuse the material ceased after regulation, which has resulted in increased land disposal of mineral resources and increased costs to industry. Presently, the fully utilized reuse of this material could produce estimated avoidable costs and savings for industry of about $24 million. However, this amount may greatly understate the potential savings as hazardous waste land disposal costs increase through the anticipated imposition of increased state taxation.

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EXECUTIVE SUMMARY

The application and impact of the Resource Conservation and Recovery Act's (RCRA) regulations on the minerals industry's efforts at resource recovery is of significant concern to the Bureau of Mines. By furthering the objectives of RCRA, to reduce land disposal and facilitate resource recovery practices through cost-effective regulation, the Bureau can further the reduction of the Nation's dependence on mineral imports, maintain a viable minerals industry, and reduce the land disposal of critical minerals. Cost-effective regulations are a very pervasive need for the minerals industry, which generates 1.2 billion metric tons of solid waste each year. In addition, the decreasing amount of adequate landfill capacity for the hazardous waste generated and shipped offsite has made it increasingly essential to promote recycling practices to reduce land disposal. However, legitimate recycling practices have been hindered and negated by the current regulations or the conflicts, which are created by their application to recyclable materials.

One conflict is the ambiguity in determining which materials are considered solid wastes and are within the Environmental Protection Agency's (EPA) jurisdiction. The EPA has interpreted the definition of solid waste very broadly to include all but a few recycling situations. However, this issue was recently reviewed by the District of Columbia Circuit Court of Appeals in *American Mining Congress* v. *Environmental Protection Agency* in which it interpreted the EPA's jurisdiction in a narrow scope to include only "truly discarded material." Unfortunately, this has done little to clarify the issue. The distinction between wastes and recyclable materials is based on the present recycling management and classification of the material. This definitive method of inclusion is still very broad, and there are few exclusions for recycling practices. In addition, the EPA and others have interpreted the court's opinion in *AMC* v. *EPA* very differently as to what materials are considered within the EPA's jurisdiction. Thus, uncertainty still exists in the application of solid waste regulations to recyclable materials and requires almost a case-by-case determination. A better method is needed to distinguish between wastes and recoverable resources, which does not create disincentives for recycling practices that are furthering the objectives of RCRA.

Another conflict is the rule that waste materials derived from listed hazardous wastes are considered hazardous wastes when interpreted in connection with the mixture rule, which requires all nonhazardous wastes combined with a hazardous waste to be considered a hazardous waste. Thus, any activity that uses even a small percentage of hazardous waste may become liable for the disposal of an even greater quantity of waste which it may generate.

The adverse impact of these regulations on resource recovery activities within the minerals industry and the opposition to the objectives of RCRA is demonstrated by a case study of the regulatory impact on the aluminum industry's spent potliner, which is a newly listed hazardous waste. This material was being recycled for legitimate economic and resource recovery purposes in environmentally sound processes, prior to regulation. These reuse processes were cement kilns, steel mills, and mineral wool plants, which used the spent potliner for its energy and fluoride values. In addition, the toxic constituent cyanide, the primary concern for the regulation of this material, is also destroyed by the high temperatures attained in these processes. However, all of these efforts to reuse the material ceased after regulation and resulted in increased land disposal of the material and increased costs to the industry. The reuse of this material by industry could produce estimated avoidable costs and savings of about $24 million,[2] if fully utilized. Thus, the regulation of this material produces results contrary to the congressionally mandated objectives of RCRA to promote recycling and reduce land disposal.

The furtherance of the environmental protection objective of RCRA is also questionable with respect to recyclable materials. Tests performed by Alumax Inc. have shown that the burning of spent potliner in cement kilns produced no contamination in emissions or products. Also, the benefits of environmental protection gained by these regulations may be insignificant or nonexistent because the risk of contamination may be increased by the increased accumulation of material in land disposal, instead of its destruction through reuse. In addition, the current regulatory scheme for recyclable materials provides for exempting accumulations of materials with recycling practices that utilize 75% of the material per year. This exemption affords little, if any, increased protectional value for the remaining 25% and inhibits developing recycling practices, which may pose a lesser risk than the unregulated percentage, but cannot meet the criteria for exemption.

[2]The cost savings for the disposal of spent potliner in hazardous waste land disposal is expected to increase in light of new state-imposed taxes in the range of $112 per ton.

As a newly listed hazardous waste, spent potliner is not presently subject to the land ban of hazardous wastes, which will require treatment of hazardous waste prior to land disposal. However, the future land disposal of spent potliner will require methods for treatment, which may, ironically, use the same process as the reuse industries, only without the benefits gained by the recovery of its resource potential and at substantially increased costs to industry.

Several conclusions can be extracted from this cursory examination of RCRA's regulatory impact on recycling practices, but the most pivotal conclusion is the need to reform the current regulatory scheme to further the objectives of Congress by establishment of cost-effective regulations that promote the development and continuance of recycling processes. These reforms need to be concerned with the evaluation and development of the resource recovery activities of a material and the removal of the stigmas, complexity, and uncertainty imposed by the regulation of materials as wastes instead of potential resources. Thus, the improvement of these regulations could lessen the economic impact on the minerals industry, improve its viability, reduce the land disposal of critical minerals, and reduce the Nation's dependence on foreign mineral resources.

INTRODUCTION

Congress established the Resource Conservation and Recovery Act (RCRA) (*1*)[3] to regulate solid and hazardous wastes. As the universe of assessed environmental risks is expanded and applied to materials that cannot be clearly distinguished as a waste or a recoverable resource, the regulation of resource recovery practices under RCRA is becoming increasingly more prevalent. However, the major objectives of RCRA are the promotion of resource recovery activities and the reduction of land disposal. The EPA was given the responsibility for achieving these objectives. Meeting these objectives also is of significant importance to the mission of the Bureau of Mines, because by ensuring that cost-effective regulations are enacted and resources not wasted, the Bureau can help reduce the Nation's dependence on imports of mineral resources, maintain a viable domestic minerals industry, and reduce the land disposal of critical minerals.

The importance of resource recovery also was supported by a recent congressional report prepared by the Office of Technology Assessment (OTA) (*2*) in anticipation of the reauthorization of RCRA in 1990. This report examined problems associated with the reduction and disposal of municipal solid wastes and found that present landfill capacity for solid waste disposal is declining such that, within the next 20 years, 80% of existing landfill facilities will close, and siting of new facilities is discouraged by regulation and public opposition. To reduce this growing problem, the report stated that recycling should be given a top priority in the reduction of solid waste because of its conservation of materials, energy savings, and potential to reduce pollution. In addition, the report found that improvements in the recycling efforts could be made if conflicts between recycling and RCRA's regulatory restrictions were resolved.

The application of the resource recovery activities in the minerals industry presents a prime opportunity to utilize these activities because of the quantity and nature of the materials and their impact on land disposal problems. In 1985, for example, the minerals industry generated an estimated 1.3 billion tons of solid waste; in contrast, only 160 million tons of municipal solid waste were generated. The importance of the minerals industry and the problems of regulation of its waste has led Congress to pass the Bevill amendment to RCRA, which exempted mine wastes from regulation until studies on regulatory justification and impacts could be completed.

Currently, under RCRA, solid wastes are distinguished in two categories: Subtitle D, solid wastes, and Subtitle C, hazardous solid wastes. Subtitle D regulations are primarily aimed at municipal landfill regulation, and Subtitle C regulations are designed to handle hazardous wastes. Under Subtitle D, the Federal Government has established guidelines for solid waste management; however, the States are responsible for setting and enforcing the regulations to meet these guidelines. The Subtitle C hazardous waste regulations are established and administered at the Federal level and involve stricter controls and compliance procedures.

[3]Italic numbers in parentheses refer to items in the list of references preceding the appendixes.

Most mine wastes are not presently being regulated; however, Subtitle C hazardous wastes regulation has already been imposed for many materials generated by mineral processing facilities. Examination of the current regulatory framework and its impact on the resource recovery activities for these materials may show that the regulations have resulted in adverse impacts on resource recovery practices and have increased land disposal of useful mineral resources. Unless changes are made in the current regulations, more mineral resources may be wasted in land disposal and the domestic minerals industry made less viable.

This study is intended to highlight some of the regulatory conflicts, which evince the need for improvement in RCRA's regulatory structure, in an effort to lessen the regulatory impact on resource recovery and further the objectives of RCRA. First, a conflict is examined in the foundation of RCRA's implementing regulations, which cause complex, uncertain, and litigious ambiguities in interpretation and application of the regulations. Then, the effects of these regulations, as applied to the aluminum industry's spent potliner, a newly listed hazardous waste, are examined, as a case study to show that RCRA's objectives are not being furthered by the current regulatory scheme.

CONGRESSIONAL OBJECTIVES

Congress established RCRA in response to the need "to reduce the amount of waste and unsalvageable materials and to provide for proper and economical solid waste disposal practices." Congress found "with respect to materials, that- (1) millions of tons of recoverable material which could be used are needlessly buried each year; (2) methods are available to separate usable materials from solid waste; and (3) the recovery and conservation of such materials can reduce the dependence of the United States on foreign resources and reduce the deficit in its balance of payments (*3*)." Thus, Congress stated that the objectives of the act are:

> to promote the protection of health and the environment and to conserve valuable material and energy resources by—
>
> *...minimizing the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitution, materials recovery, properly conducted recycling and reuse, and treatment;*
>
> *...promoting a national research and development program for improved solid waste management and resource conservation techniques, more effective organizational arrangements, and new and improved methods of collection, separation, and recovery and recycling of solid wastes and environmentally safe disposal of nonrecoverable residues;*
>
> *...promoting the demonstration, construction, and application of solid waste management, resource recovery, and resource conservation systems which preserve and enhance the quality of air, water, and land resources; and*
>
> *...establishing a cooperative effort among the Federal, State, and local governments and private enterprise in order to recover valuable materials and energy from solid waste (4) (emphasis added).*

As emphasized, a major part of RCRA's objectives is the development of alternatives to land disposal and, in particular, aiding in the establishment of recycling and other methods of material conservation. Thus, these objectives require that resource recovery be an integral part of the regulatory framework.

The impetus for any regulatory constraints on recoverable materials was expressed by Congress in the 1984 amendments of RCRA. The House Committee on Energy and Commerce examined recycling practices and included sections in the 1984 amendments to curb illegitimate or environmentally unsound recycling activities. In particular, the committee found that the EPA's regulations addressing the burning of hazardous wastes as a fuel and the burning of waste-derived fuels were deficient. Thus, Congress amended RCRA to include restrictive provisions to regulate these activities. In addition, Congress directed the EPA "to examine the entire range of hazardous waste use, reuse, recycling, and reclamation activities in order to choose which should be regulated as necessary to protect human health and the environment (*5*)."

About the same time, the EPA explained the need for increased controls on recycling in the preamble to the proposed final rule (48 FR 14472) on the definition of "solid waste." It stated that wastes destined for recycling could endanger human health and the environment if managed improperly. Therefore, the Agency increased control over recycled materials by interpreting "solid waste" to include recycled material. Also, the EPA stated that certain recycling activities lessen the potential risk of harm and tried to avoid regulations which discourage recycling by providing exclusions for activities "where existing commercial or marketing incentives appear sufficient to protect against substantial environmental harm."

THE REGULATION OF RECYCLABLE MATERIALS

THE BASIC RULES

Recycled materials are defined by the EPA as solid wastes by looking at the recycled practice and the classification of the material. Thus, the following analysis must be made to determine if the recycled activities are subject to regulation as a solid waste:

> If the material is a scrap metal or a listed or characteristic[4] hazardous spent material,[5] sludge, or byproduct, and is recycled[6] by being placed on the land, burned for energy, used to produce a fuel, or speculatively accumulated,[7] it is considered a solid waste;
>
> If the material is a listed or characteristic commercial chemical product and is recycled by being placed on land, burned as fuel, or used to produce a fuel, it is a solid waste unless it is the ordinary manner of use; or
>
> If the material is a listed or characteristic spent material, or a listed sludge or byproduct, the material is considered to be a solid waste when reclaimed.[8]

The regulations also identify and exclude three activities as not being solid wastes because they resemble ordinary production operations or the ordinary use of commercial products. These activities are—

> The use or reuse of secondary materials as ingredients in industrial processes, provided the materials are not being reclaimed;
>
> The use or reuse of secondary materials as effective substitutes for commercial products; and
>
> The return of secondary materials to the original primary production process in which they are generated without first reclaiming them.

However, these exclusions do not apply to hazardous secondary materials used as fuels or as ingredients in waste derived fuels, to hazardous secondary materials placed directly on land or used in products that will be placed on land, or to hazardous secondary materials that are speculatively accumulated.

The regulations also define three circumstances in which recycled materials which are considered solid wastes may be eligible for a variance on a case-by-case basis:

> Materials accumulated without sufficient amounts being recycled, if it can be demonstrated that sufficient amounts will be recycled in the following year;
>
> Materials that are reclaimed and then used as a feedstock within the original primary production process in which they were generated; and
>
> Materials that are reclaimed but must be reclaimed further before material recovery is completed.

In addition, certain materials are defined as solid wastes regardless of the recycling activity, if they are determined and listed as "inherently waste-like" by the criteria in 40 CFR sec. 261.2(d). These criteria state that the material be ordinarily disposed of, burned, or incinerated; or contain listed toxic constituents, which are not ordinarily found in raw materials or products in larger

---

[4]A listed waste is a material which the EPA has determined to be a hazardous waste by the criteria in 40 CFR sec. 261.11 and is specifically listed in Subpart D. A characteristic material is a material which demonstrates the criteria for a characteristic hazardous material as set out in 40 CFR sec. 261.10.

[5]A material is considered to be a spent material if it has been used and can no longer serve the purpose for which it was produced.

[6]A material is recycled if it is used, reused, or reclaimed.

[7]A material which is accumulated speculatively is considered a solid waste unless it can be shown that the material is potentially recyclable by a feasible means and at least 75% of the material in a calendar year is transferred to a recycling facility. The calculation of percentage requires that a particular material be recycled in the same way.

[8]A reclaimed material is a material which is processed to recover a usable product or is regenerated.

concentrations, and the material poses a substantial hazard to human health and the environment when recycled. Finally, the regulations provide for exclusions of specific materials in 40 CFR sec. 261.4. Thus, these regulations are primarily based on the definition of solid waste with a few narrow exclusions for resource recovery practices.

PROBLEMS IN INTERPRETATION

The regulations promulgated by the EPA for recycled materials were recently examined by the District of Columbia Circuit Court of Appeals in *American Mining Congress* v. *EPA*, 824 F. 2d 1177 (D.C. Cir. 1987). This case was brought by representatives of the minerals industry to determine whether recycled materials were a solid waste within the jurisdiction of the EPA. In particular, the court's concern centered on waste rock which was reprocessed for extraction of additional metal and was believed to be included in the EPA's definition of "solid waste." The court considered the definition and interpreted that, for recycled material to be within the EPA's jurisdiction, a material first must be considered a "discarded material." Then, the court interpreted the congressional intent in the definition of a "discarded material:"

> To the contrary, a fair reading of the legislative history reveals intimations of an intent to regulate under RCRA only materials that have been truly discarded. Not only is the language of the legislative history fully consistent with the use of 'discarded' in the sense of 'disposed of,' but it strains the language to read it otherwise (*6*).

The issue before the court in *AMC* v. *EPA* was the regulation of spent material in an ongoing manufacturing or industrial process. The court reasoned that materials destined for beneficial reuse or recycling in a continuous process by the generating industry itself were not part of the waste disposal problem and were not a danger to human health or the environment. Therefore, it found that it was not the intent of Congress to have included these materials within the purview of RCRA and ruled, two to one, that the EPA had exceeded its statutory authority by regulating these recycled materials. However, the wording of the court can be interpreted either broadly or narrowly, with respect to the exclusion of recycled material from regulation. The Lead Industries Association has commented (*7*) that, in its view, "EPA has no authority to regulate any smelting of secondary material for lead recovery, regardless of whether the material is 'indigenous'" to the process.

On the other hand, the EPA has interpreted this case narrowly, removing from its jurisdiction and regulation only materials that "are characterized by continuous extraction of material values from an original raw material" (53 FR 519) and returned to the same manufacturing process. In addition, the EPA does not interpret the court's opinion to mean final disposition of a material is required to be a discarded material. Thus, the Agency believes that some recycling activities involving the discarding of secondary materials may remain within its jurisdiction. The EPA also makes no distinction between on-site or offsite recycling activities to be a limiting factor on its jurisdiction over recovery activities.

Clearly, the ad hoc inclusion of a recyclable material within definition of "solid waste" has created a complex ambiguity as to the EPA's jurisdiction. This ambiguity has been made even less clear by the various interpretations of the court's opinion in *AMC* v. *EPA*. As it stands, further litigation is almost assured to clarify the bounds of the EPA's jurisdiction with respect to other materials which have resource recovery potential. In addition, the complexity of the regulations and the uncertainty, which has evolved, require almost a case-by-case decision as to whether the process is considered to be within the EPA's jurisdiction.

In regard to the minerals industry, the EPA examined the court's opinion in *AMC* v. *EPA* regarding the reclamation of secondary materials for the extraction of precious metals and determined that it believed the special applicable standards (*8*) for these materials were unaltered. In addition, the Agency explained its understanding of the court's opinion by using the aluminum industry's spent potliner as an example in which material recovery could involve the disposal of byproducts and sludges in operations that are not an ongoing, continuous production process and thus, the EPA could retain its jurisdiction. In this example, the EPA stated:

> Spent potliners, containing high concentrations of cyanide, could be disposed of through storage prior to potential recovery of cryolite values (as fluoride) but not for any recycling of the cyanide. This reclamation step is ancillary to the main process (aluminum production), since fluoride is not returned to the process to be recovered as a product (rather, it is a component in the potliner), and the potliners themselves are dissimilar to raw materials used originally. The lack of cyanide recovery indicates a waste treatment objective (53 FR 521).

This example of the EPA's interpretation of its jurisdiction over the spent potliner material is of interest, because the material is further examined, in this article, as a case study to analyze the impact that these current regulations have on the recoverable resources and provides a glimpse into the EPA's understanding of the problem and resource potential.

THE ALUMINUM INDUSTRY'S SPENT POTLINER, A CASE STUDY

BACKGROUND

Spent aluminum potliner is generated within the electrolytic process of primary aluminum reduction, which reduces alumina[9] to primary aluminum metal.[10] In 1989, there were 23 domestic primary aluminum reduction plants in operation, which produced an estimated 4,000,000 metric tons of aluminum (*9*).

The electrolytic process is a continuous reaction taking place in "pots" containing a molten bath of electrolyte and alumina. The "pots" are made of a steel shell lined with insulation and carbon. The carbon liner serves as the cathode, and a carbon anode is placed on top of the bath. The insulation and carbon liner is typically considered to be potliner by industry; however, the EPA presently only defines the carbon portion as being potliner. Between 3 to 7 years after the process begins, the cathode potliner breaks down due to penetration of the aluminum and other constituents of the bath. The pot then must be taken off-line and the potliner replaced. Each spent potliner contains typically an average of 60 tons of a heterogeneous mixture of carbon, aluminum, sodium, fluoride, silicon, calcium, and trace amounts of cyanide and iron. A typical plant may have 300 to 500 pots, from which the domestic aluminum industry generates approximately 130,000 metric tons of spent potliner material each year.

In 1986, the Aluminum Association examined 31 pots and estimated that only 15% to 25% of the total amount of spent potliner material generated by the industry contained hazardous amounts of cyanide. As a conclusion, the association stated that the wide variance in cyanide content did not justify a specific source listing as a hazardous waste. However, the EPA listed spent potliner as a hazardous waste on September 13, 1988,[11] stating that the cyanide contaminant levels in spent potliner may present a significant threat to the environment and human health if managed improperly, citing case examples of cyanide contamination as further justification (*10*).

To regulate spent potliner, the EPA stated that, under its interpretation of *AMC* v. *EPA*, spent potliner is determined to be a solid waste and within its jurisdiction. Its reasoning is that the material is taken from a process and is no longer used in that process; thus, it is a discarded waste by being a spent material, and the recovery processes are "not characterized by ongoing, continuous production processes." As such, the EPA stated as an example that the recovery of fluoride from spent potliner is indicative of a waste treatment objective (53 FR 519) because it is ancillary to the main process of aluminum reduction; the potliners are dissimilar to the original raw materials; and there is a "lack of cyanide recycling."

THE EFFECTS OF REGULATION

In March 1988, about 22% of the total generated tonnage of spent potliner was being reused by the cement, mineral wool, and steel industries to recover both the fluoride and energy values (17% was being stored in anticipation of potential use and the remaining 61% was being land disposed). However, since spent potliner's listing as a hazardous waste, virtually all efforts and existing practices to extract its intrinsic values have ceased, and the aluminum industry has been forced to place spent potliner in either on-site storage enclosures or hazardous waste landfills.[12]

Alumax's Mt. Holly Plant in South Carolina, for instance, was shipping its spent potliner to Santee Cement Company for use in its kiln, prior to the EPA's listing. After the listing, Santee could no longer handle the material without getting a permit, and it has not done so. International Aluminum Company (Intalco) and Kaiser Aluminum and Chemical Corporation contacted more than 20 cement companies in attempts to locate those willing to handle spent potliner. All of the companies queried declined to use spent potliner, stating reasons of regulatory requirements, uncertainty, and adverse public reaction to a listed hazardous waste. A mineral wool producer that had received and used spent potliner, for 3 years prior to the listing, has also stopped due to the regulatory requirements. In addition, steel plants and powerplants surveyed by Alumax and Intalco have refused to consider using spent potliner for reasons including fear of further regulation, adverse public reaction, and increased liability (*11-12*).

The listing of spent potliner has additionally subjected the aluminum industry to an unlimited responsibility to ensure its environmentally sound disposition. As a generator of a hazardous waste, the aluminum industry may be found liable for damages even after the material has left their control through placement in land disposal. Even regulatory compliance will not insulate a generator from an indefinite liability potential caused by other parties'

[9]Most alumina (Al_2O_3) is produced by the Bayer process (a hydrometallurgical process) from bauxite ore and typically contains less than 1% impurities.

[10]Appendix A contains a more thorough description of the aluminum reduction process.

[11]Appendix B gives the regulatory history of the hazardous waste listing of spent potliner.

[12]One company continues to roast spent potliner to generate aggregate for resale.

improper management. Thus, the industry is forced to entrust these liability risks to the management of present land disposal facilities and future unknown management.

The reuse industries also are exposed to disproportionally increased liability by the regulation of spent potliner. The "derived from rule" causes the residues generated from listed wastes to remain a hazardous waste subject to Subtitle C regulation. In addition, the "mixture rule" requires that any other intermingled wastes be considered hazardous wastes as well. In this situation, these residues may be considerably greater in amount than the initial input of hazardous material. Thus, unless the secondary facilities' wastes are delisted on a site-by-site basis, the reuse industries are classified as generators and subjected to the same indefinite increases in liability risks as the aluminum industry. The delisting procedure requires that each facility must demonstrate that the residuals do not meet any of the criteria under which the waste was listed. In addition, the EPA administrator can retain the residues as a hazardous waste if other constituents exist which could cause it to be a hazardous waste.

THE LEGITIMACY OF RECYCLING SPENT POTLINER

As stated by Congress, a primary intent or objective of RCRA is to further recycling practices that are legitimate. As the following materials evince, the practices being used to recycle spent potliner were legitimate efforts by being technically workable, economically viable, and environmentally sound.

Proven Technology *(13)*

The Production of Mineral Wool: Spent potliner had been used on a commercial scale by mineral wool plants as a process feedstock source of fluoride and as a fuel substitute for coke. The potliner is crushed, ground, and burned in a cupola with other feedstock. The fluorides are incorporated in the mineral wool product, and the energy value of the carbon is recovered as a supplemental fuel.

Combustion in Cement Kilns: Cement kilns had been able to use spent potliner on a commercial scale as a fuel supplement replacing 2% to 5% of the coal used. Tests have also shown that the fluoride contained in the spent potliner increases the reaction process within the kilns, reducing the required temperatures and fuel costs without any detrimental effects on production rates or cement quality.

Fluxes in Steel Mills: Steel plants had used spent potlining for several years. In this process, the spent potliner is ground and burned in the oxygen furnace where the carbon is utilized as a partial substitute for coke and the fluoride acts as a substitute for the fluxing agent, fluorspar. Studies performed by the Bureau of Mines with the Aluminum Company of America (Alcoa) showed that the fluoride content of spent potliner was the equivalent to fluorspar and its use produced no degradation in metal quality nor severe adverse effects in the process operation.

Economic Viability

The aluminum industry's smelting operations account for 85% of the total cost of aluminum production. As such, the industry has historically reused, recycled, reduced, and recovered materials to reduce waste and lower costs. Thus, spent potliner is of significant interest to the aluminum industry because it offers a wealth of resource potential and represents a large portion of their solid waste stream. The energy and mineral resource value consists primarily of the carbon and fluoride constituents. The energy value in the carbon content can be between 3,000 to 9,000 Btu per pound, about one-half that of coal which is approximately 14,000 Btu per pound *(11-12)*. The spent potliner's fluoride content of 14% to 26% by weight makes it a significant mineral resource supplement for fluorspar.

These energy and mineral values make spent potliner acceptable for use in other industries which allow the aluminum industry to avoid the high costs of land disposal, which is approximately $188.50[13] per ton of material. In contrast, the recycling costs incurred in grinding and transporting the material to a cement kiln is only about $37 per ton. Thus, the regulatory disposal cost savings to the aluminum industry could amount to about $151.50 per ton which, considering only the 22% of the material actually being recycled prior to regulation, would have produced an annual savings for the industry of approximately $4.3 million. However, if the process were fully instituted, the annual savings for the aluminum industry could have amounted to about $19.7 million.

The savings to the reuse industries must also be considered in the value of spent potliner. The mineral wool and steel plants used the spent potliner as a fuel supplement, replacing coke costing approximately $120 per ton,

[13]This is the average estimated cost of disposal ($131) plus the average estimated cost of transportation ($57.50), which was taken from EPA's, Technical Background Document, Development of the Cost, Economic, and Small Business Impacts Arising from the Reinterpretation of the Bevill Exclusion for Mineral Processing Wastes, Aug. 18, 1989, (docket No. MWRF-S0002).

and as a source of fluoride, replacing fluorspar costing approximately $80 per ton, and the cement plants used the material as a low cost supplemental fuel, replacing coal costing $30 per ton. In addition, the added fluoride content of spent potliner lowers the cement kiln operating temperatures resulting in additional fuel savings. Using only the cost of coal at a 1:1 replacement value for a conservative estimate, the 22% of spent potliner that was reused prior to regulation would have saved about $860,000 in annual fuel costs, and, if all of the spent potliner had been reused, the reuse industries could have saved approximately $4 million per year.[14] These savings to the aluminum industry and the savings value of spent potliner to the reuse industries demonstrate that, prior to regulation, reusing the spent potliner had a legitimate economic basis for resource recovery.

Environmental Soundness

The primary environmental justification for these regulations is the possible cyanide contamination. However, there is little contamination hazard associated with these recycling processes because the high temperatures attained in the combustion process destroy the cyanide constituent. Tests performed by Alumax, Inc. (*14*), on cement kilns burning spent potliner have shown that no cyanide contamination was detected in the product or emissions. Thus, the only significant risk is from the cyanide generated by exposure of spent potliner to the elements during storage and handling. However, this environmental hazard may not be lowered by regulation because the risk of contamination from an increase in the total accumulation of material in land disposal may be greater than the risk imposed by improper management of the material destined to be recycled and destroyed.

The present exemptions from regulations for recycled materials also may discriminate against small and developing recycling practices by requiring variances or regulatory compliance measures in low recycled percentage situations. Under the current regulatory scheme, a material is exempt from regulation if the material is not "speculatively accumulated," which requires that more than 75% of the total generated amount must be recycled each year. The EPA uses this 75% recycled test as an indicator of adequate commercial markets for the material. A less recycled percentage is allowed to seek a variance but only under three narrowly allowed situations.[15] These provisions suggest that the higher market incentive is reflective of lower environmental dangers and disposal problems. However, the environmental risks imposed by the remaining 25% of the marketable and exempt material could be extremely significant and yet unregulated, whereas, a less recycled percentage of another material must seek a case-by-case determined variance, if possible, even if the risks are insignificant. This exemption requirement is arbitrarily related to environmental safeguards and may stifle new or developing resource recovery practices. If the EPA finds that improper storage or handling of the remaining 25% of a material that is exempt and does not present environmental risks justifying regulation, then it would seem equally justified to provide an exemption for small percentages of a recycled material. Thus, the environmental risks should not be significant from the management of an exempt 25% portion of any recyclable material.

THE FUTURE OUTLOOK FOR SPENT POTLINER

Land disposal and on-site storage of spent potliner cannot be continued indefinitely under the present practical and regulatory conditions which will be imposed by the land ban. At present, the spent potliner is a newly listed waste which is not subject to the land ban. However, this ban is a mandated eventuality which will require the treatment of hazardous wastes to diminish its toxicity or migration potential before it can be land disposed.[16] Ironically, the most practical treatment method for spent potliner may be to burn it in kilns like those which were reusing it prior to regulation. Unfortunately, the prior symbiotic incentives for these activities have been discouraged by the present regulatory framework.

THE NEGATION OF RCRA'S OBJECTIVES

The objectives of RCRA are to protect the environment and human health, encourage legitimate resource recovery, and minimize land disposal of solid waste. As shown, the regulation of spent potliner has in effect negated rather than promoted the development of these legitimate resource recovery practices, increased land disposal, and provided questionable environmental protection. Thus, in this case, the consequences show that the regulations are producing effects that are contrary to RCRA's objectives.

[14]This assumes, as information suggests, that any increase in costs to handle the spent potliner were insignificant prior to regulation.

[15]The three situations for allowing a variance are listed in the basic rules section.

[16]Currently, spent potliner is considered a newly listed waste; however, a recent court challenge has been made claiming that the material is a pre-1984 waste. If successful, the mandatory land ban for the material will be accelerated because the material would be required to be classified as a third waste.

SUMMARY AND RECOMMENDATIONS

Congress created RCRA for three main objectives: (1) to protect health and the environment, (2) to recover and conserve valuable energy and material resources, and (3) to reduce the solid waste disposal problem. These are **not** mutually exclusive objectives and, with the finding that the landfill option is becoming a less viable option, it is increasingly important that regulations promote the development of new or existing recycling technology. However, under the current regulatory scheme, conflicts exist which can hinder these objectives.

The conflicts in the interpretation of RCRA as applied to recyclable materials has created ambiguities, which hinder development of resource recovery activities. The definition of a solid waste is one such ambiguity, which, until it is resolved, will stifle development of recycling activities because of the uncertainty and complexity of regulation. As shown in the spent potliner case, the application of these regulations results in a loss of valuable energy and mineral resources, offers questionable environmental protection, discriminates against developing recycling practices, and increases land disposal of valuable materials. Thus, the congressional mandate to promote recycling, decrease land disposal, and protect the environment as called for in RCRA is not being furthered by the regulation of spent potliner.

These problems manifest a need for reforms of present regulations for legitimate recyclable materials. These reforms must remove the stigmas, uncertainty, and complexity imposed by regulation of these materials as a solid or hazardous waste. A more precise method to distinguish recyclable materials from wastes, a distinct regulatory framework with minimal effects on legitimate recycling practices, and regulations that provide affirmative incentives, not penalties, for legitimate recycling practices, would go a long way toward furthering RCRA's objectives of resource recovery, material conservation, and minimizing land disposal. As such, these improvements to the regulatory framework could lessen the economic impact on the minerals industry, reduce the land disposal of mineral resources, and reduce the Nation's dependence on foreign mineral resources.

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APPENDIX A.—THE ALUMINUM REDUCTION PROCESS

The reduction process produces aluminum by electrolysis of alumina in "pots" containing a molten bath of cryolite (Na_3AlF_6) and aluminum fluoride (AlF_3), which serves as an electrolyte and as a solvent for the alumina (Al_2O_3). The pots are large, flat-bottomed vessels, which commonly have a steel shell, 15 feet by 30 feet by 6 feet high, which is lined with insulation refractory, carbon blocks, and rammed carbon material. The carbon lining serves as the cathode for the electrolytic process, and the anode is a carbon block suspended above the cryolite surface. A typical plant may have 300 to 500 pots. See figure A-1.

The reduction process is continuous. The electrical current maintains the cryolite at molten temperatures of about 1,800° F and reduces the alumina into molten aluminum metal. The aluminum then collects at the cathode by pooling in the bottom of the pot and the carbon anodes are consumed by the oxygen released from the alumina. Every 1 or 2 days the molten aluminum is removed from the pot by a vacuum siphon and more alumina is added to the bath from time to time to maintain a concentration in the bath of about 20%. When necessary, cryolite or aluminum fluoride is added to the bath to maintain the desirable ratio of sodium and aluminum fluoride and to replace the fluoride lost into the potlining or through ventilation (*15*).[1]

[1]Italic numbers in parentheses refer to items in the list of references preceding the appendixes.

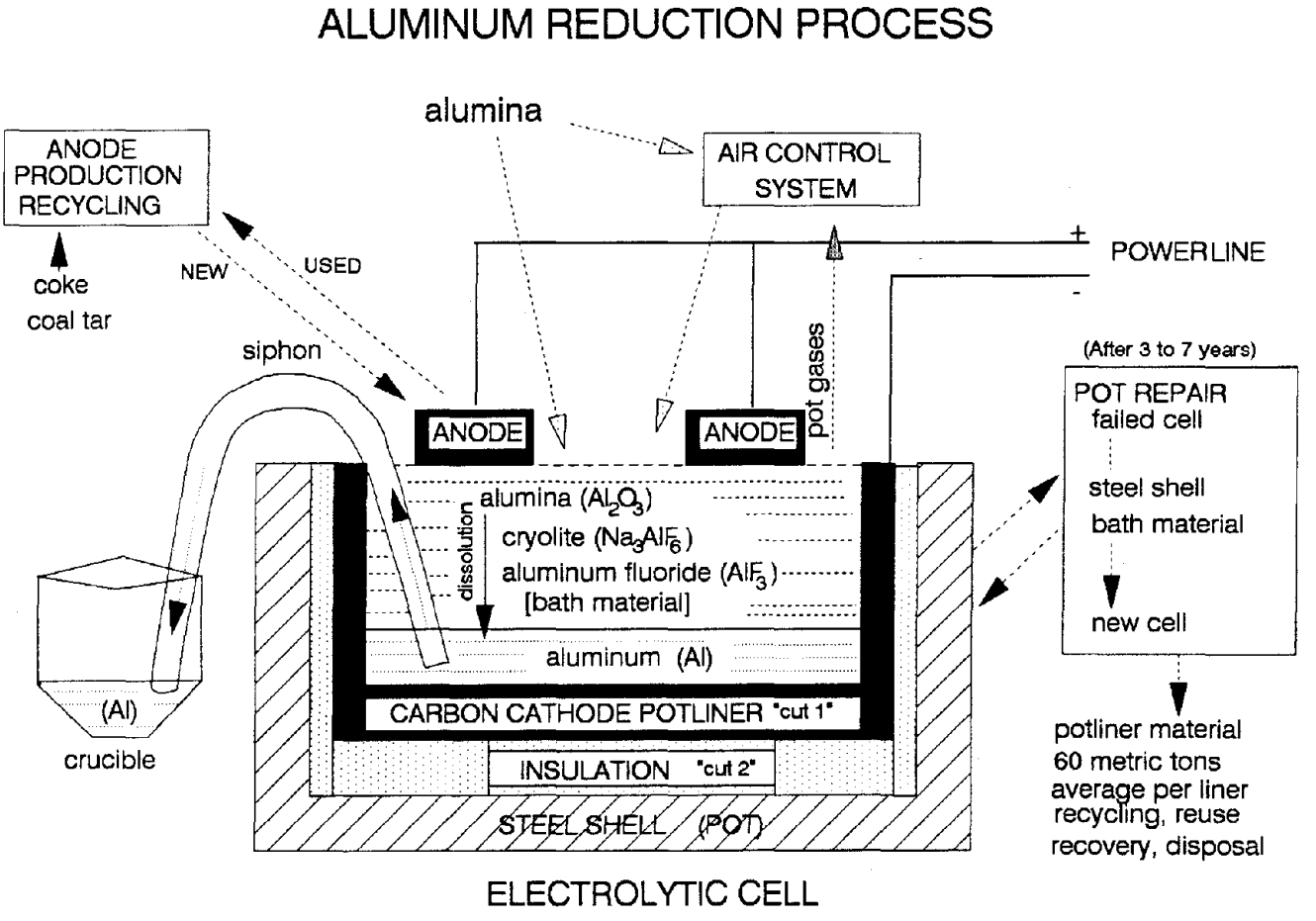

Figure A-1.—Flow diagram of aluminum reduction process.

Between 3 to 7 years, the cathode potliner breaks down due to penetration by aluminum and other constituents of the bath. The pot must then be taken off-line and the potliner replaced. Each spent potliner contains, typically, an average of 60 tons of a heterogeneous mixture of carbon, aluminum, sodium, fluoride, silicon, calcium, and trace amounts of cyanide and iron. The actual percentage of these constituents varies among plants and within the potliner itself. However, the potliner constituents can be distinguished into two "cuts." "Cut 1" is the upper portion or carbonaceous section of the potliner; it may contain up to 60% carbon and is about two-thirds of the total volume of the potliner. See table A-1. "Cut 2" is the lower one-third portion of the potliner and consists of a refractory of mainly alumina or silica brick (*11-12*). The domestic aluminum industry generates approximately 130,000 metric tons[2] of spent potliner material each year.

[2]Estimated total based on generation and production rates and includes both 'cut 1' and 'cut 2' fractions. The Aluminum Association estimates present generation to be between 110,000 and 120,000 metric tons per year.

Table A.-1.—Typical content of spent potliner "cut 1"

Contents	Range of weight %
Major constituents:	
C	23.0-55.0
F	13.9-26.6
Na	11.5-18.2
Al	4.7-15.8
Ca	1.0- 1.2
Si	0.1- 4.8
Trace constituents:	
Fe	.3- .9
CN	.1- .3

APPENDIX B.—THE REGULATORY HISTORY OF THE LISTING OF SPENT POTLINER

On July 16, 1980, the EPA ruled that spent potliner was a hazardous waste falling under RCRA Subtitle C regulation (45 FR 47834). However, the EPA temporarily suspended the listing on January 16, 1981, when the Bevill amendment to RCRA was enacted excluding mine wastes from Subtitle C regulation until a study was completed to determine what regulatory restrictions were necessary (46 FR 4614). The EPA did not meet the statutorily required date for the report. This resulted in a lawsuit, *Concerned Citizens of Adamstown* v. *EPA*, (*16*)[1] in which the D.C. Circuit Court of Appeals ordered the EPA to file the report by December 31, 1985, or to make a determination on spent potliner by September 30, 1986. On October 2, 1985, the EPA proposed the relisting of spent potliner as a hazardous waste (50 FR 40292); however, this proposed relisting was withdrawn on October 9, 1986 (51 FR 36233), when the agency determined that it failed to set out "practical applicable criteria for distinguishing processing from non-processing wastes." This withdrawal prompted another lawsuit, *Environmental Defense Fund* v. *EPA*, (*17*) in which the court found that the withdrawal of the proposed relistings were arbitrary because the wastes would clearly not qualify under any interpretation of the "high volume/low toxicity" criteria of the mine waste exclusion. Thus, it directed the EPA to relist the wastes, including spent potliner, by August 31, 1988. The EPA relisted spent potliner as a hazardous waste on September 13, 1988, with an explanation that spent potliner is omitted from the Bevill exclusion because of differences in volume and chemical composition from the excluded wastes, and it is not part of the raw material processing stream (53 FR 35412).

The cyanide contaminant levels in spent potliner are the primary basis for the EPA's determination that it may present a significant threat to the environment and human health if managed improperly. The EPA's toxicity test showed that free cyanide and iron cyanide could leach from spent potliner when exposed to rainwater, resulting in free cyanide concentrations as high as 210 mg/L and the total cyanide concentrations as high as 230 mg/L. To justify the listing, the EPA also cites case examples of cyanide contamination of an aquifer and other media from spent potliner leachate (*18*). In addition, the EPA also found that the leachate contains more than double the water standard of acceptable fluoride concentration, and when exposed to sunlight, the spent potliner might decompose to release toxic hydrogen cyanide into the air.

According to industry sources, the cyanide is apparently produced by the bonding of carbon and nitrogen in the electrolytic process and is then absorbed into the potliner. However, the amount of cyanide contained within the material depends on its location within the pot. "Cut 1" contains more cyanide than "cut 2," which is primarily insulation material. The Aluminum Association examined and tested 31 pots, finding that most samples from the second "cut" classified as nonhazardous material, using the 20 mg/L standard for cyanide concentration. Although this could amount to one-third of the spent potliner generated, the nature of the materials make practical separation of the "cuts" difficult, but industry representatives believe that the cost of separation would not be prohibitively uneconomical.

[1]Italic numbers in parentheses refer to items in the list of references preceding the appendixes.