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Report to Congress on Special Wastes from Mineral Processing

Summary and Findings

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Summary and Findings

1.0 Introduction

In October, 1980, the Resource Conservation and Recovery Act (RCRA) was amended by adding §3001(b)(3)(A)(ii) to exclude "solid waste from the extraction, beneficiation, and processing of ores and minerals" from regulation as hazardous waste under Subtitle C of RCRA, pending completion of a study and a Report to Congress required by §8002(f) and (p) and a determination by the EPA Administrator either to promulgate regulations under Subtitle C or that such regulations are unwarranted (as required by §3001(b)(3)(C)). EPA modified its hazardous waste regulations in November 1980 to reflect this "Mining Waste Exclusion," and issued a preliminary, and quite broad, interpretation of the scope of its coverage. In particular, EPA interpreted the exclusion to include "solid waste from the exploration, mining, milling, smelting and refining of ores and minerals" (45 FR 76618, November 19, 1980).

In 1984, EPA was sued for failing to submit the Report to Congress and make the required regulatory determination by the statutory deadline (*Concerned Citizens of Adamstown v. EPA* No. 84-3041, D.D.C., August 21, 1985). In responding to this lawsuit, the Agency explained that it planned to propose a narrower interpretation of the scope of the Mining Waste Exclusion, so that it would encompass fewer wastes, and proposed to the Court two schedules: one for completing the §8002 studies of extraction and beneficiation wastes and submitting the Report to Congress for these wastes, and one for proposing and promulgating a reinterpretation for mineral processing wastes. In so doing, the Agency, in effect, split the wastes that might be eligible for exclusion from regulation into two groups: mining (mineral extraction and beneficiation) wastes, and mineral processing wastes. The Court agreed to this approach and established a schedule for the two tasks.

On December 31, 1985, EPA published the required Report to Congress on solid wastes from mineral extraction and beneficiation,[1] and on July 3, 1986 (51 FR 24496) published a determination that regulation of such wastes under Subtitle C of RCRA was not warranted. Since the determination was made, the Agency has been developing a tailored regulatory approach for these materials under the auspices of RCRA Subtitle D. In May, 1988, EPA issued a staff-level approach for regulating mining wastes (referred to as "Strawman") for public comment. More recently, the Agency issued a revised staff-level approach ("Strawman II") that incorporates comments from and responds to issues raised by the states, environmental groups, and the regulated community. The Agency is working to develop a formal proposal of a regulatory program for mineral extraction and beneficiation wastes.[2]

In keeping with its Court-ordered directive to reinterpret the Mining Waste Exclusion for mineral processing wastes, in October, 1985, EPA proposed to narrow the scope of the Exclusion for mineral processing wastes to include only a few specific waste streams. However, the Agency did not specify the criteria that it used to identify these materials, or to distinguish them from other wastes that were not eligible for the exclusion. In response to this proposal, many companies and industry organizations "nominated" wastes that they believed were eligible for the regulatory exemption. Faced with an inability at that time to articulate

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[1] U. S. Environmental Protection Agency, 1985. Report to Congress on Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale, EPA/530-SW-85-033, Washington, D.C. Available from the U.S. Department of Commerce, National Technical Information Service, Springfield, VA. NTIS Document No. PB88-162631.

[2] The Agency has recently requested comments on Strawman II, including the appropriate scope of the program (i.e., which wastes should be covered).

criteria that could be used to distinguish exempt from non-exempt wastes and the approaching Court-ordered deadline for final action, EPA withdrew its proposal on October 9, 1986.

In response to this action, the Agency was sued again. In July, 1988, the court in *Environmental Defense Fund v. EPA*, 852 F.2d 1316 (D. C. Cir. 1988), *cert. denied*, 109 S. Ct. 1120 (1989) ordered EPA to reinterpret the scope of the Exclusion for mineral processing wastes according to a new schedule. In particular, EPA was directed by the court to restrict the scope of the Exclusion as it applied to mineral processing wastes to include only "large volume, low hazard" wastes. In a series of rulemaking notices, EPA has, during the past two years, established the boundaries of the Mining Waste Exclusion for mineral processing wastes, and has articulated the criteria that were used to define "mineral processing" and to evaluate whether individual wastes are large volume and low hazard and, thus, eligible for the temporary exclusion provided by RCRA §3001(b)(3)(A)(ii). This rulemaking process was completed with the publication of a final rule on January 23, 1990 (55 FR 2322).[3] With the completion of these notices, the Agency established that the temporary exemption from Subtitle C requirements established by the Exclusion for mineral processing wastes and, therefore, the scope of this report, is limited to 20 mineral processing wastes generated by 91 facilities located in 29 states, representing 12 mineral commodity sectors. In particular, this report covers the following wastes:

- Alumina
  - -- red and brown muds from bauxite refining
- Chromium (Sodium chromate/dichromate)
  - -- treated residue from roasting/leaching of chrome ore
- Coal gas
  - -- gasifier ash from coal gasification
  - -- process wastewater from coal gasification
- Copper
  - -- slag from primary processing
  - -- calcium sulfate wastewater treatment plant sludge from primary processing
  - -- slag tailings from primary processing
- Elemental phosphorus
  - -- slag from primary production
- Ferrous metals (iron and carbon steel)
  - -- iron blast furnace air pollution control dust/sludge
  - -- iron blast furnace slag
  - -- basic oxygen furnace and open hearth furnace air pollution control dust/sludge
  - -- basic oxygen furnace and open hearth furnace slag
- Hydrofluoric acid
  - -- fluorogypsum
  - -- process wastewater
- Lead
  - -- slag from primary processing
- Magnesium
  - -- process wastewater from primary magnesium processing by the anhydrous process

[3] This rulemaking process also included publication of a proposed rule on October 20, 1988 (53 FR 41288), a proposed rule on April 17, 1989 (54 FR 15316), a final rule on September 1, 1989 (54 FR 36592), and a proposed rule on September 25, 1989 (54 FR 39298).

- Phosphoric acid
  - -- phosphogypsum
  - -- process wastewater
- Titanium tetrachloride
  - -- chloride process waste solids
- Zinc
  - -- slag from primary processing

All other solid wastes from the processing of ores and minerals were removed from the Mining Waste Exclusion as of the effective date of the September 1, 1989 or January 23, 1990 final rules (March 1, 1990, or July 23, 1990 in non-authorized states), and are subject to regulation as hazardous wastes if they exhibit one or more characteristics of hazardous waste or are otherwise listed as hazardous waste.[4]

A summary of the important events in the rulemaking process and of the criteria that have been developed by the Agency to identify the 20 special wastes from mineral processing operations is presented in Appendix A to the report (contained in Volume III).

Following receipt and analysis of public comment on this report, the Agency will issue the regulatory determination required by RCRA §3001(b)(3)(C) that will either subject one or more of the 20 special mineral processing wastes to regulation under Subtitle C as hazardous wastes or conclude that such regulation is unwarranted. Wastes for which the Exclusion is retained will continue to be subject to regulation under RCRA Subtitle D as solid wastes. Our assessment of risk in this report has been based on a conservative set of risk assumptions. If additional regulation of these wastes is determined to be necessary, we would make such a determination with this in mind.

2.0 RCRA §8002(p) Study Factors

This report addresses the following eight study factors required by §8002(p) of RCRA for the 20 mineral processing wastes listed above:

1. The sources and volumes of such materials generated per year;
2. Present disposal and utilization practices;
3. Potential danger to human health and the environment from the disposal and reuse of such materials;
4. Documented cases in which danger to human health or the environment has been proved;
5. Alternatives to current disposal methods;
6. The costs of such alternatives;
7. The impacts of these alternatives on the use of phosphate rock, uranium ore, and other natural resources; and

[4] Because the requirements of the September 1, 1989 and January 23, 1990 final rules were not imposed pursuant to the Hazardous and Solid Waste Amendments of 1984, they will not be effective in RCRA authorized states until the state program amendments are effective. Thus, the rules are effective on March 1, 1990 and July 23, 1990 (for the September 1, 1989 and January 23, 1990 rules, respectively) only in those states that do not have final authorization to operate their own hazardous waste programs in lieu of the Federal program. In authorized states, the rules are not applicable until the state revises its program to adopt equivalent requirements under state law and receives authorization for these new requirements. (Of course, the requirements will be applicable as state law if the state law is effective prior to authorization.) States that have final authorization must revise their programs to adopt equivalent standards regulating non-exempt mineral processing wastes that exhibit hazardous characteristics as hazardous by July 1, 1991 if regulatory changes only are necessary, or by July 1, 1992 if statutory changes are necessary. Once EPA approves the revision, the state requirements become RCRA Subtitle C requirements in that state.

8. The current and potential utilization of such materials.

The Agency's approach in preparing this report was to combine certain study factors for purposes of analysis and exposition. The resulting discussions, which are found in individual chapters (in Volume II) addressing each of the mineral commodity sectors, are organized in seven sections. The first section provides a brief overview of the industry, including the types of production processes used and the number and location of operating facilities that generate one or more mineral processing special wastes. The second section summarizes information on special waste characteristics, generation, and current management practices (study factors 1 and 2), while the third section provides a discussion of potential for and documented cases of danger to human health or the environment (study factors 3 and 4). The fourth section (as suggested by § 8002(p) of RCRA, independent of the eight study factors) summarizes applicable federal and state regulatory controls. The fifth section discusses alternative waste management practices and potential utilization of the wastes (study factors 5 and 8), while the sixth section discusses costs and impacts of alternative practices (study factors 6 and 7). The seventh and final section summarizes and analyzes the findings of EPA's evaluation of the above study factors.

3.0 Methods, Information Sources and Decision Rationale

In preparing this report, EPA has developed facility-specific data and analytical methods that reflect the complexity of the issues that are addressed herein. The facilities that generate the special study wastes vary considerably in the types of production operations and waste management techniques that they employ. Moreover, to examine in detail the broad array of study factors mandated by RCRA §8002(p), EPA had to develop approaches and methods that were sufficiently sophisticated to take into account the special nature of high volume mineral processing wastes. This section briefly outlines the data sources, methods, and decision rationale that the Agency employed to respond to the study factors.

3.1 EPA Data Collection Activities

EPA's Office of Solid Waste conducted a number of data collection activities to supplement and update previous work. The focus of most of these efforts was site-specific. As a consequence, EPA has been able to compile detailed facility- and sector-specific data bases, which the Agency has used extensively to prepare this report as well as a series of rulemakings which, as discussed above, have clarified the boundaries of the Mining Waste Exclusion as it applies to mineral processing wastes. The major information-gathering initiatives are as follows:

- Review of Public Comments
- 1989 National Survey of Solid Wastes from Mineral Processing Facilities (SWMPF Survey)
- 1989 EPA Mineral Processing Waste Sampling and Analysis
- EPA Damage Case Collection
- EPA Site Visits
- RCRA §3007 Waste Characteristics Data Requests

These activities are described in more detail in Chapter 2 of Volume II, with additional discussion and/or examples provided in Appendix B, which is contained in Volume III.

3.2 Analytical Approach and Methods

This section summarizes EPA's approach for addressing each of the study factors.

Waste Characteristics, Generation, and Current Management Practices

To characterize the generation and management of each of the 20 special mineral processing wastes, EPA had to identify the facilities that generate the wastes, the production processes used and the products produced, the quantity and characteristics of the wastes generated, and the practices that are employed to manage them.

The identification of the facilities that generate one or more of the 20 special wastes was based upon prior EPA work, supplemented extensively by information provided by Commodity Specialists with the U.S. Bureau of Mines. The operators of these facilities then were sent a survey questionnaire (SWMPF Survey) requesting information on waste generation and management. Survey responses allowed EPA to finalize its list of the active facilities in the mineral processing sectors of concern, and serve as the primary basis of EPA's understanding of the current management practices that are applied to special wastes from mineral processing operations.

Information submitted by industry in response to the SWMPF Survey was supplemented with and critically evaluated against data obtained from published sources, information collected as part of the damage case development process, and EPA observations made during waste sampling and other site visits. The descriptions of waste management practices provided in this report reflect EPA's synthesis of the information obtained during all of these information collection activities.

Potential and Documented Danger to Human Health and the Environment

Potential Danger to Human Health and the Environment

EPA conducted a facility-specific analysis of the risks associated with each of the 20 mineral processing wastes. The Agency collected information on the major factors that influence risks from the management of the special wastes at each of the 91 facilities that generate the wastes, and analyzed this information to develop conclusions on the potential for toxic constituents to be released from the waste and cause human health and environmental impacts. In a limited number of cases, EPA also conducted quantitative risk modeling to estimate potential danger to human health and the environment.

EPA employed a three step approach in this risk assessment, using each step as a means of narrowing the scope of the analysis to those wastes and facilities that pose the greatest potential risk. First, the Agency assessed the intrinsic hazard of the wastes by comparing the concentrations of toxic constituents in the wastes and in leachate from the wastes to screening criteria.[5] This step was used to determine which, if any, constituents of the special wastes may pose risks to human health and the environment based on reasonable, but conservative exposure assumptions. Second, EPA assessed the potential for toxic constituents from the subject wastes to cause damage at the 91 facilities by evaluating the practices currently used to manage the wastes and the environmental settings in which the wastes are managed. Using facility-specific information about special waste management and environmental setting, EPA then evaluated the potential for toxic or radioactive constituents to be released from the specific waste management units and to migrate to potential exposure points. Finally, for waste stream/environmental settings combinations at which risk potential appeared to be the greatest, EPA performed quantitative modeling to estimate the human health and environmental risks associated with existing waste management practices.

In all steps of the analysis, EPA focused on human health and environmental risks associated with chronic exposure to potential releases of waste constituents to ground water, surface water, and air. When possible, however, the Agency did evaluate the potential for large episodic releases of waste constituents (e.g., from storm or flood events) to endanger human health or the environment. To analyze risks to human health,

[5]The focus of the screening criteria is on toxicity and radioactivity, in addition to a simple determination of corrosivity. EPA has sufficient knowledge of the characteristics of the 20 special mineral processing wastes to conclude that none are ignitable or reactive.

the Agency evaluated the cancer and noncancer risks to maximally exposed individuals at each site. To analyze environmental risks, the Agency evaluated the potential for contaminants to migrate from the waste and adversely affect aquatic organisms. In addition to risks to human health and aquatic life, EPA also evaluated the potential for existing waste management practices to reduce the quality of water and air resources by considering the potential for air and water contamination, irrespective of the potential for humans or ecological receptors to be exposed to the contamination.

Documented Cases of Danger to Human Health or the Environment

Section 8002(p)(4) of RCRA requires that EPA's study of mineral processing wastes examine "documented cases in which danger to human health or the environment has been proved." In order to address this requirement, EPA defined danger to human health and the environment in the following way. First, danger to human health includes both acute and chronic effects associated with management of mineral processing wastes. Second, danger to the environment includes: (1) impairment of natural resources; (2) ecological effects resulting in impairment of the structure or function of natural ecosystems and habitats; and (3) effects on wildlife resulting in impairment to terrestrial or aquatic species.

The statutory requirement is that EPA examine "proven" cases of danger to human health or the environment. As a result, EPA developed a "test of proof" to be used for determining if documentation available on a case proves that danger/damage has occurred. This "test of proof" contains three separate tests; a case that satisfies one or more of these tests is considered "proven." The tests are as follows:

1. Scientific investigation: Damages are found to exist as part of the findings of a scientific study. Such studies include both extensive formal investigations supporting litigation or a State enforcement action and the results of technical tests (such as monitoring of wells). Scientific studies must demonstrate that damages are significant in terms of impacts on human health or the environment. For example, information on contamination of a drinking water aquifer must indicate that contamination levels exceed drinking water standards.
2. Administrative ruling: Damages are found to exist through a formal administrative ruling, such as the conclusions of a site report by a field inspector, or through existence of an enforcement action that cited specific health or environmental damages.
3. Court decision: Damages are found to exist through the ruling of a court or through an out-of-court settlement.

EPA has taken care in the course of preparing this evaluation to report only damages that are relevant to the decisions that will be based upon the Report to Congress (i.e., whether regulation of each of the special wastes from mineral processing under Subtitle C is appropriate). Consequently, the damage cases reported here are believed to be attributable (at least in part) to the special study wastes, and are believed to have resulted from management practices that are currently employed by active facilities in the commodity sectors of interest.

Existing Federal and State Waste Management Controls

In accordance with the suggestion in RCRA §8002(p), EPA has also examined other applicable federal and state waste management controls in an effort to minimize duplication.

Federal Controls

EPA's objective in this analysis was to identify and evaluate the existing regulatory controls over the management of special mineral processing wastes that have been promulgated by agencies of the federal government, focusing on programs and requirements established by EPA. This evaluation was performed for

two reasons. First, some states do not have regulatory programs, meaning that federal requirements apply directly. Second, the federal government has not delegated authority to states for implementing some environmental protection statutes and regulations.

The initial phase of the analysis examined the relevant statutes and regulations pertaining to hazardous waste, solid waste, air quality, and water quality as they might apply to the management of the mineral processing special wastes, in general. The second phase of this analysis was to identify and evaluate any specific regulations that pertain to any of the 20 special mineral processing wastes. The final phase of the analysis involved contacting Regional EPA staff in those states that do not have federally approved programs for implementation of the major environmental statutes, as well as relevant staff within other federal agencies and departments, and performing a regulatory analysis of the implementation of all existing federal statutes and regulations that pertain specifically to the management of the 20 special mineral processing wastes. The findings of this review are contained within the twelve commodity-specific chapters, while descriptions of the major federal statutes and regulations that affect mineral processing wastes management generally are provided in Appendix D-1 (in Volume III).

Requirements in Selected States

EPA's goal in this analysis was to determine the current regulatory stance of states with regard to the mineral processing wastes generated by the 12 commodity sectors addressed in this report. The analysis serves more generally to help characterize current waste management and disposal practices taking place as a result of state regulation.

The first step in the analysis focused on reviewing material in a previous EPA-sponsored study on state-level regulation of mining and mineral processing wastes. The second step of EPA's analysis was to perform a more detailed review of individual state statutes and regulations; this review was limited in scope to a representative sample (18) of the 29 states containing facilities of interest for further analysis. While this more detailed study addressed, in part, the regulatory status of special mineral processing wastes, EPA found that the scope of state programs was not always clear from the state statutory and regulatory language that was reviewed. The final step of EPA's analysis, therefore, consisted of contacting state officials involved with the implementation of legal requirements in order to learn how those statutes and regulations are interpreted in practice, and to obtain facility-specific implementation information. The information compiled from these contacts was combined with the existing information on statutory and regulatory requirements to produce a final implementation analysis, which describes the existing regulatory structure applicable to the 20 mineral processing wastes generated by the twelve commodity sectors considered in this Report to Congress.

Alternative Management Practices and Potential Utilization

Section 8002(p) of the RCRA statute requires that EPA consider alternatives to current disposal methods, as well as the current and potential utilization of the wastes addressed by the Report to Congress. In order to accomplish this, this report identifies demonstrated alternatives for waste management and utilization. The costs, current use, potential use, and environmental impact of each alternative are evaluated to the extent permitted by the information available.

Because the primary purpose of this report is to determine whether the regulation of the special mineral processing wastes under Subtitle C is warranted, EPA focused its efforts and the discussion of waste management alternatives presented herein on those wastes that potentially may be candidates for Subtitle C regulation, excluding consideration of the costs and impacts of the various scenarios.

The focus of this analysis was on conducting a comprehensive computer-assisted literature search, then evaluating the information obtained thereby. In some instances, more detailed information was solicited from individual researchers, agencies, and trade associations. Detailed discussion of alternatives is limited in scope, however, to those for which information is adequate to assess their technical feasibility (i.e., EPA has not

generally included alternatives that are experimental, unproven, or have not seen at least pilot-scale application).

Cost and Economic Impacts

Section 8002(p) of RCRA requires EPA to analyze "alternatives to current disposal methods" for solid wastes generated from the extraction, beneficiation, and processing of ores and minerals. EPA is also required to analyze "the costs of such alternatives." Section 6 of each commodity-specific chapter (in Volume II) discusses the costs and associated economic impacts of alternative waste management practices. The analysis of costs and impacts is limited in scope to those waste streams that exhibit one or more characteristics of hazardous waste and/or exhibit documented damage or potential risk.

The focus of the analysis is on the comparative operational and financial consequences of regulating these materials under various regulatory schemes. First, cost and impacts are calculated for regulation of these wastes under full Subtitle C of RCRA. Two less stringent regulatory scenarios are also considered, one of which reflects the potential for relaxed hazardous waste management controls found at §3004(x) of RCRA ("Subtitle C-Minus"), while the other is a hypothetical Subtitle D program designed to specifically address mineral processing wastes ("Subtitle D-Plus").

The incremental costs associated with alternative regulatory options are compared to several financial indicators at the facility level in order to determine the relative magnitude of potential impacts. In addition, the Agency has evaluated market conditions facing each affected facility and sector to assess the extent to which facilities potentially facing compliance costs would be able to pass through these costs to various product markets or force reductions in the cost of inputs (e.g., ore concentrate, labor).

In conducting this cost analysis, EPA has assumed, in most cases, that waste streams are potentially hazardous at only the individual facilities for which data submitted by industry or EPA sampling data indicate that the waste exhibits one or more of the four characteristics of a hazardous waste, as defined by 40 CFR Part 261 Subpart C. When wastes do exhibit a hazardous waste characteristic, it is assumed that the waste(s) would be regulated as hazardous waste were it not for the exclusion provided by RCRA §3001(b)(3)(A)(ii), and the wastes are examined in the cost analysis accordingly.

3.3 Decision Rationale

EPA has developed two alternative approaches to analyze the information presented in this report regarding each of the 20 special wastes from mineral processing. Both approaches share a three-step process that the Agency used to evaluate the RCRA §8002(p) study factors by first assessing the need for additional regulatory controls (or absence thereof), then evaluating the options for appropriate requirements that could be applied to each individual waste stream for which additional controls might be in order, and, finally, estimate the associated costs and impacts. The second approach is distinguished from the first by the addition of a fourth step in which the Agency considered additional factors based on broader Agency goals and objectives. By applying this decision-making framework, consistent decisions regarding the need for additional regulatory controls for each of the 20 special study wastes were achieved.

In applying the decision criteria, EPA believes that the factors that are most important in establishing the regulatory status of the special wastes should be given major emphasis. Therefore, potential risks posed and documented damages caused by the wastes, the need for additional regulations, the costs and impacts that would be associated with more stringent regulatory controls, and overall Agency objectives are the focus of the four steps in the analysis process. The reason for this is that in the absence of potential risk and/or documented damages, there is no need for hazardous waste regulation under RCRA Subtitle C (the key issue in question); if greater regulatory controls are needed because of significant potential or documented danger, the costs and impacts of regulatory controls are the critical factors in determining whether a given alternative would lead to the desired outcome (adequate protection of human health and the environment <u>and</u> continued operation of the affected industries).

It should be noted that EPA has done its best to develop and analyze alternatives to current disposal methods. However, these scenarios represent an assessment of how regulatory requirements might be tailored to reflect the unusual characteristics of mineral processing wastes, that is, the assumptions made here in developing these scenarios may not resemble any actual Subtitle C-Minus or Subtitle D-Plus requirements that may be developed by the Agency in the future. As a result, EPA solicits comments on the regulatory scenarios that the Agency has used and the appropriateness of the underlying assumptions for the possible future development of regulatory programs under Subtitle D or under Subtitle C using the flexibility provided by RCRA §3004(x).

In considering whether Subtitle C regulation may be warranted or not, EPA is considering how or whether to implement the flexibility provided by RCRA §3004(x) to the extent that it can do so and continue to ensure human health and environmental protection. Specifically, EPA would consider this flexibility in establishing treatment standards for land disposal of these newly identified wastes under 40 CFR Part 268 in separate rulemaking under §3004(g)(4) and would develop corrective action requirements on a site-specific basis as part of the permitting process. With respect to the flexibility for minimum technology requirements (§3004(o) and §3005(j)), EPA solicits comments on how best to implement the flexibility provided by §3004(x), such as establishing requirements on a site-specific basis as part of the permitting process or development of revised standards under Subtitle C regulations.

The step-wise process that the Agency applied to the available information is outlined below.

Step 1. Does management of this waste pose human health/environmental problems? Might current practices cause problems in the future?

Critical to the Agency's decision-making process is whether each special waste either has caused or may cause human health or environmental damage. To resolve this issue, EPA has posed the following key questions:

1. Has the waste, as currently managed, caused documented human health impacts or environmental damage?
2. Does EPA's analysis indicate that the waste may pose a significant risk to human health or the environment at any of the sites that generate it (or in off-site use), under either current management practices or plausible mis-management scenarios?
3. Does the waste exhibit any of the characteristics of hazardous waste?

If the answer to any of these three questions was yes, then EPA concluded that further evaluation was necessary. If the answer to all of these questions was no, then the Agency tentatively concluded that regulation of the waste under RCRA Subtitle C is unwarranted.

Step 2. Is more stringent regulation necessary and desirable?

If the waste has caused or may potentially cause human health or environmental impacts under conservative risk assumptions, then EPA concluded that an examination of alternative regulatory controls was appropriate. Given the context and purpose of the present study, the Agency focused on an evaluation of the likelihood that such impacts might continue or arise in the absence of Subtitle C regulation, by posing the following three questions:

1. Are current practices adequate to limit contaminant release and associated risk?
2. What is the likelihood of new facilities opening in the future and generating and managing the special waste in a different environmental setting than those examined for this report?

3. Are current federal and state regulatory controls adequate to address the management of the waste?

If current practices or existing regulatory controls are adequate, and if the potential for actual future impacts is low (e.g., facilities in remote locations, low probability of new facilities being constructed, low likelihood of actual risk), then the Agency may tentatively conclude that regulation of the waste under Subtitle C is unwarranted. Otherwise, further examination of regulatory alternatives is necessary.

Step 3. What would be the operational and economic consequences of a decision to regulate a special waste under Subtitle C?

If, based upon the previous two steps, EPA believed that a waste might potentially be a candidate for regulation under Subtitle C, then the Agency estimated and evaluated the costs and impacts of two regulatory alternatives that are based upon Subtitle C, and one alternative that reflects one possible approach that might be taken under RCRA Subtitle D ("Subtitle D-Plus"). Two evaluations were performed. The first focused on the magnitude, distribution, and significance of the incremental costs of regulation under full Subtitle C as compared to the Subtitle D-Plus scenario for each potentially affected facility. The second focused on incremental costs and impacts associated with regulation under the Subtitle C-Minus scenario as compared to Subtitle D-Plus. The key questions in the Agency's decision-making process for both comparisons were as follows:

1. Are predicted economic impacts associated with the full Subtitle C (or Subtitle C-Minus in the case of the second comparison) scenario significant for any of the affected facilities?
2. Are these impacts substantially greater than those that would be experienced under the Subtitle D-Plus scenario?
3. What is the likely extent to which compliance costs could be passed through to product markets or input costs could be reduced, i.e., to what extent could regulatory cost burdens be shared?
4. In the event that costs are significant, could a large proportion of domestic capacity or product consumption be affected?
5. What effects would hazardous waste regulation have upon the viability of the beneficial use or recycling of the special waste?

In EPA's judgment, an ability to pass through costs or an absence of significant impacts suggested that Subtitle C regulation (or Subtitle C-Minus in the case of the second comparison) might be appropriate for wastes that pose significant risk. In cases in which the Subtitle C (or Subtitle C-Minus) scenario would impose widespread and significant impacts on facilities, result in reductions in domestic capacity or supply, and/or deter the safe and beneficial use of the waste, EPA tentatively concluded that regulation under some form of Subtitle D program might be more appropriate.

Step 4. Additional Considerations

In this fourth step, which EPA only included in one of the two decision-making approaches, EPA considered factors in addition to the §8002(p) study factors that relate to the broader goals and objectives of the Agency, including developing and maintaining strong state programs to regulate mining and mineral processing wastes. EPA believes that it may be appropriate to facilitate both development and maintenance of strong state programs and implementation of federal regulations for mineral processing wastes by regulating all special wastes from mineral processing under the mining wastes program being developed under Subtitle D of RCRA. The relevance of these additional factors, and their impact on EPA's findings, is discussed below.

4.0 Findings

Section 3001(b)(3)(C) of RCRA requires that the Agency determine, based on the findings of this report, and public hearings and comment, either to promulgate regulations under Subtitle C of RCRA for the wastes covered by this study or determine that such regulations are unwarranted. Accordingly, to facilitate comment on this report and the subsequent preparation by the Agency of the required "regulatory determination," this section presents EPA's findings regarding the 20 special wastes from mineral processing based on two separate approaches. These two approaches include:

- Application of the RCRA §8002(p) Study Factors, which discusses the regulatory approach (i.e., Subtitle D or Subtitle C) that the Agency tentatively concludes is appropriate for each of the 20 mineral processing wastes if the study factors listed in the statute alone are considered; and
- Application of the RCRA §8002(p) Study Factors and Additional Considerations, which discusses (1) additional factors that the Agency believes may be appropriate to consider in making a "regulatory determination" and (2) the tentative conclusions that may be drawn that include consideration of these additional factors.

EPA solicits comments on both of these approaches and the tentative conclusions presented below. With respect to the decision-making approaches, EPA solicits comments on: (1) what factors the Agency should consider in making the required regulatory determination; (2) what information should be used to evaluate these factors; and (3) the relative weight that the factors should be given in developing a regulatory determination.

4.1 Application of the RCRA §8002(p) Study Factors: Approach 1

As discussed above, RCRA §8002(p) specifies eight factors that the Agency shall include in the analysis performed for this report and suggests that EPA also examine federal and state agency programs to avoid duplication of effort. This section presents a summary of the Agency's analysis of these factors and the possible conclusions, pending receipt and analysis of public comments, that EPA might make regarding the appropriate regulatory status of the 20 mineral processing special wastes covered by this report. The 20 mineral processing special wastes are discussed in two groups: (1) wastes that the Agency might recommend regulating under Subtitle D of RCRA; and (2) wastes that the Agency might tentatively consider for regulation under Subtitles C or D.

Wastes EPA Might Tentatively Recommend to Remain Under RCRA Subtitle D

The available data, the analysis presented in this report, and consideration of the RCRA §8002(p) study factors suggest that regulation under Subtitle C of RCRA is unwarranted for the following 16 mineral processing wastes:

- Red and brown muds from bauxite refining;
- Treated residue from roasting/leaching of chrome ore;
- Gasifier ash from coal gasification;
- Process wastewater from coal gasification;
- Slag from primary copper processing;
- Slag tailings from primary copper processing;
- Slag from elemental phosphorus production;
- Iron blast furnace slag;
- Basic oxygen furnace and open hearth furnace slag from carbon steel production;

- Air pollution control dust/sludge from iron blast furnaces;
- Air pollution control dust/sludge from basic oxygen furnaces and open hearth furnaces from carbon steel production;
- Fluorogypsum from hydrofluoric acid production;
- Process wastewater from primary magnesium processing by the anhydrous process;
- Process wastewater from phosphoric acid production;
- Phosphogypsum from phosphoric acid production; and
- Slag from primary zinc processing.

In using the study factors listed in RCRA §8002(p), EPA used the approach described above in Section 3 to examine: (1) the potential for and documented danger to human health and the environment; (2) the need for additional regulations; and (3) the costs and impacts of Subtitle C regulation.

EPA did not find significant actual or potential danger associated with the following three wastes, based on waste characteristics, management practices, and damage case investigations:

- Treated residue from roasting/leaching of chrome ore;
- Process wastewater from coal gasification; and
- Slag tailings from primary copper processing.

None of these wastes exhibit a characteristic of hazardous waste and no documented damages were identified as associated with their management.

The other thirteen wastes listed above were identified as having some actual or potential hazard associated with current management practices or plausible mismanagement scenarios, and so were subsequently evaluated in the second stage of the process.

In the second stage of the evaluation, EPA identified four wastes that did not exhibit a hazardous characteristic (with the exception of one sample of copper slag at one facility) but for which documented cases of adverse environmental impacts that affected surface water were identified at at least one facility:

- Iron blast furnace slag;
- Slag from primary copper processing;
- Basic oxygen furnace and open hearth furnace slag from carbon steel production; and
- Fluorogypsum from hydrofluoric acid production.

In all four cases, however, these surface water releases (one of which occurred via ground water) have been and/or are being addressed under existing regulatory authorities at the state and/or federal level. In addition, the potential for risks associated with management of these wastes at potential new facilities is not likely to be greater than at the existing facilities. In the case of fluorogypsum, however, the available data indicate that the radionuclide content of the waste is such that under some circumstances (e.g., use of the wastes in construction) the waste may pose some radiation risk. As a result, EPA plans to investigate further the potential for exposure and associated radiation risk for fluorogypsum and, if appropriate, take steps to limit such risks under authorities provided by RCRA and other statutes.

EPA found that two wastes exhibited one or more of the hazardous characteristics, slag from primary zinc processing and process wastewater from primary magnesium processing by the anhydrous process. However, each is generated by a single facility, neither of which have documented damages after about 50 and 20 years of operation, respectively. In both cases, market conditions and production processes are such that construction of additional facilities in the foreseeable future is unlikely. In addition, state regulations are in effect for the one primary magnesium facility and being revised/strengthened for the primary zinc processing facility. EPA plans to investigate further off-site uses of zinc slag for uses that constitute disposal.

In addition, EPA found that the available data indicate that air pollution control (APC) dust/sludge from iron blast furnaces and from basic oxygen and open hearth furnaces used to make carbon steel exhibit the characteristic of EP toxicity at some facilities. For both types of dust and sludge, relatively few of the samples and facilities tested yielded EP-toxic results (for at most two constituents) and the magnitude of the exceedances was generally low. No damage cases were identified for either type of dust/sludge, either for on-site or off-site management. In addition, several facilities recycle rather than dispose the dust, the facilities are generally not in high risk settings, and construction of new facilities is not likely.

EPA also found that the potential for hazard associated with two other wastes, red and brown muds from bauxite refining and gasifier ash from coal gasification, was comparatively low, except for the radionuclide content of the wastes; in addition, no documented damages attributable to these two wastes were identified.[6] For both of these wastes, however, available data indicate that under some circumstances (e.g., use of the wastes in home building materials) the wastes may pose some radiation risk. As a result, EPA plans to investigate further the potential for exposure and associated radiation risk associated with use of these two mineral processing special wastes and, if appropriate, take steps to limit such risks under authorities provided by statutes other than RCRA.

The radionuclide content, and the associated potential for radiation risk, is also of concern in three other wastes: slag from elemental phosphorus production, and phosphogypsum and process wastewater from phosphoric acid production. With respect to slag from elemental phosphorus production, EPA found that average life-time cancer risks range from $4x10^{-4}$ to $1x10^{-3}$ in Soda Springs and Pocatello, Idaho as a result of the use of the slag in a wide range of construction applications. In other respects, the potential and documented danger associated with non-radioactive contaminants contained in elemental phosphorus slag appears to be relatively low because: (1) the slag does not exhibit any of the characteristics of hazardous waste; and (2) there are no documented damage cases.[7] In addition, construction of additional facilities in the foreseeable future appears unlikely. EPA plans to use the authority of RCRA §3001(b)(3)(B)(iii) to ban the use of this material in construction and/or land reclamation when the Agency issues its regulatory determination for mineral processing wastes. EPA is soliciting comments on the appropriate regulatory language that should be used and how such a ban should be implemented.

In the case of phosphogypsum, radionuclide hazards associated with air releases from gypsum stacks and off-site uses of phosphogypsum are being addressed by the Agency under 40 CFR, Part 61, Subpart R, National Emission Standards for Hazardous Air Pollutants (NESHAP), Radon Emissions from Phosphogypsum Stacks (54 FR 51654, December 15, 1989; 55 FR 13480, April 10, 1990; 55 FR 13482, April 10, 1990).

Phosphogypsum and phosphoric acid process wastewater are also of concern because damage case information indicates that both closed and currently active phosphogypsum stacks (in which both the phosphogypsum and the wastewater are managed) and wastewater cooling ponds have caused and/or are causing ground-water contamination at many facilities. In addition, available data indicate that phosphogypsum tested EP toxic at one of ten facilities, and process wastewater exhibits the characteristic of corrosivity at most facilities and the EP-toxicity characteristic at some facilities. Current regulations are apparently not adequate to prevent contamination (although this situation may change as state regulatory programs improve), so the potential costs of regulation under Subtitle C were examined in the third stage of the evaluation. EPA estimated that the incremental annualized cost of either full Subtitle C regulation or the Subtitle C-Minus scenario for phosphogypsum and process wastewater, as compared to the Subtitle D-Plus scenario developed for cost estimating purposes, could exceed $500 million and $50 million respectively, and could significantly affect several facilities. At facilities that EPA estimates could be significantly affected by costs associated with the Subtitle C or Subtitle C-Minus scenarios, the estimated costs of the Subtitle D-Plus

[6] Ground-water contamination at the Dakota Gasification facility in North Dakota was identified, but the source of the contamination appears to be wastes other than the gasifier ash.

[7] Ground-water contamination has been identified at one site, but it appears that wastewater was the source rather than slag.

scenario, expressed as a percent of the value of shipments, are substantially less at seven facilities. The estimated impacts associated with Subtitle C or C-Minus regulation at these facilities would be expected to be significant, and it is unlikely that these facilities could pass along their higher costs. EPA considered the combined costs of Subtitle C requirements for phosphogypsum and process wastewater because: (1) these two wastes are typically co-managed; and (2) the compliance costs associated with both wastes would apply to each facility. EPA is aware, however, that only a portion of the total process wastewater flow is typically co-managed with the phosphogypsum. The Agency may investigate the feasibility of separate management of these wastes, as well as separating various wastewater streams in the context of this decisionmaking and the development of the mining waste program under Subtitle D.

In any case, however, EPA is concerned that under some circumstances process wastewater from phosphoric acid may pose some radiation risk that would not be addressed by the NESHAP regulation noted above. As a result, EPA plans to investigate further the potential for exposure and associated radiation risk associated with this waste and, if appropriate, take steps to limit such risks under authorities provided by RCRA and other statutes.

Wastes EPA Might Tentatively Consider for Regulation Under RCRA Subtitles C or D

For the remaining four wastes (calcium sulfate wastewater treatment plant sludge from primary copper processing, slag from primary lead processing, process wastewater from hydrofluoric acid production, and chloride process waste solids from titanium tetrachloride production), EPA proceeded to evaluate the estimated incremental compliance costs and associated impacts in Step 3 of the analysis in two ways. First, EPA examined the estimated costs of regulation under Subtitle D (using the "D-Plus" scenario) relative to the estimated costs of full Subtitle C regulation (Approach 1A). Second, EPA examined the estimated cost of Subtitle D-Plus regulation relative to the cost of regulation under a Subtitle C scenario that utilizes flexibility provided by RCRA §3004(x) (Approach 1B). These two analyses are discussed below along with the results of analysis Steps 1 and 2 for each of the wastes. As already indicated, the Subtitle C-Minus and Subtitle D-Plus scenarios are based on the Agency's preliminary assessment of how regulatory requirements might be tailored for mineral processing wastes. Because of this, the Agency is unsure whether the cost/impacts in these comparisons are fully appropriate and specifically requests comments on them. The fact that a hypothetical Subtitle D-Plus scenario was used for comparison does not mean that any or all of these wastes will necessarily be proposed for further regulation.

Comparison of Subtitle D-Plus and Full Subtitle C (Approach 1A)

In applying Steps 1 and 2 of the analysis process, EPA found that each of these four special wastes have posed or may pose a danger to health or the environment. Available data indicate that all four of the wastes exhibit one or more of the characteristics of hazardous wastes. All of the wastes except process wastewater from hydrofluoric acid production exhibit the characteristic of EP toxicity at at least one facility. Process wastewater from hydrofluoric acid production is corrosive at all facilities where it is generated. Documented damages associated with current lead slag management practices were identified and the potential for damages exists for the other wastes as well. Ground-water contamination that may in part be attributable to calcium sulfate sludge from primary copper processing and chloride process waste solids from titanium tetrachloride production was identified at at least one facility that generates one of these wastes.[8]

In addition, the Agency is not confident that current practices and regulations are adequate to prevent further danger to health or the environment from these four wastes. Specific reasons are as follows:

[8] Attribution of the observed ground-water contamination at these sites was not possible due to co-management of the special wastes with other wastes, the close proximity of other waste management units, and/or a long history of production and waste management activities at the site.

- Current management practices for hydrofluoric acid process wastewater have not prevented release at one of the currently active facilities. There is a potential for development of additional domestic hydrofluoric acid production capacity, and the corresponding construction of new facilities. New facilities may be located in sensitive environmental settings given that the principal feedstock (acid-grade fluorspar) is generally imported and facility locations with ready access to water transportation are most likely.

- In the case of calcium sulfate wastewater treatment plant sludge from primary copper processing, applicable solid waste regulations are limited in states where it is currently generated and generation of this waste at additional facilities appears likely.[9] At least some of these additional facilities are in environmental settings that may have a greater potential for risk than the facilities where the waste is currently generated. Groundwater contamination at one facility may be due at least in part to disposal of the sludge.

- Current management practices contributing to documented damages associated with lead slag are not adequately addressed by current regulations.

- Chloride process waste solids from titanium tetrachloride production are generated by facilities in eight states, some of which have relatively few solid waste regulations that are applicable to the management of this waste. Construction of several new facilities is expected and these facilities may be located in sensitive environmental settings given that the principal feedstock is generally imported and facility locations with ready access to water transportation are most likely. In addition, EPA is concerned that under some circumstances, chloride process waste solids from titanium tetrachloride production may pose some radiation risk. As a result, EPA plans to investigate further the potential for exposure and associated radiation risk associated with this waste and, if appropriate, take steps to limit such risks under authorities provided by RCRA and other statutes.

To conduct Step 3 of the analysis process under Approach 1A, EPA estimated the cost of regulating each of these wastes under full Subtitle C requirements. The Agency then compared the costs for full Subtitle C regulation to the estimated costs that might result from regulation under Subtitle D requirements similar to those being developed for mining wastes ("Subtitle D-Plus"). For three of the four wastes (calcium sulfate wastewater treatment plant sludge from primary copper processing, slag from primary lead processing, and chloride process waste solids from titanium tetrachloride production), the estimated costs for full Subtitle C regulation would be significantly larger and the associated impacts would be more significant at nearly all facilities than the estimated costs of regulation under the Subtitle D-Plus scenario. Using this approach, EPA would tentatively conclude that regulation of these three wastes under Subtitle C is not warranted.

For process wastewater from hydrofluoric acid production, EPA found that the estimated compliance costs for regulation under full Subtitle C and regulation under the Subtitle D-Plus scenario were comparable and that the likely economic impacts were not expected to be significant. Using this approach to the cost analysis, EPA would tentatively conclude that process wastewater from hydrofluoric acid production may warrant regulation under Subtitle C.

Comparison of Subtitle D-Plus and Subtitle C-Minus (Approach 1B)

Under Approach 1B to conducting Step 3, EPA estimated the cost of managing these four wastes under a Subtitle C scenario that utilizes flexibility provided by RCRA §3004(x) (Subtitle C-Minus). The Agency then compared the costs for Subtitle C-Minus regulation (rather than full Subtitle C regulation, as in Approach 1A) to the estimated costs that might result from regulation under Subtitle D requirements similar

[9] Additional facilities where the calcium sulfate wastewater treatment sludge may be generated include both existing copper smelting/refining facilities that do not currently generate the waste and potential new smelting/refining facilities, including a facility on the Gulf Coast of Texas.

to those being developed for mining wastes (Subtitle D-Plus). EPA found that the estimated costs for the Subtitle C-Minus and Subtitle D-Plus scenarios are similar for nearly all facilities.

4.2 Application of the RCRA §8002(p) Study Factors and Additional Considerations: Approach 2

Section 8002(p) of RCRA and the decision in *Environmental Defense Fund v. EPA*, 852 F.2d 1309 (D.C. Cir. 1988) make it clear that the Agency may and should consider the specific factors of §8002(p)(1)-(8) in making its decision regarding the appropriate regulatory status of special wastes from mineral processing. In addition, the Agency believes that it may be appropriate to consider other factors relating to the broader goals and objectives of the Agency, such as developing and maintaining strong state mining and mineral processing waste regulatory programs and facilitating implementation of federal programs (see Step 4 of the discussion of the decision rationale in Section 3.3 above).

The analysis of the §8002(p) study factors presented above indicates that management of one, and perhaps as many as four, mineral processing special wastes may be appropriate for regulation under Subtitle C if only the study factors are considered, primarily because: (1) they have or could pose a significant risk to human health and the environment under current management practices or plausible mismanagement scenarios; and (2) the costs and impacts of regulation under full Subtitle C (for one waste) or Subtitle C-Minus (for three additional wastes) are estimated to be comparable to the costs associated with regulation under a Subtitle D-Plus program. In the case of process wastewater from hydrofluoric acid production, the estimated costs for the various scenarios are similar in large part because EPA has projected that requirements that would be protective of human health and the environment under Subtitle C-Minus, and under full Subtitle C as well, might be similar to those that may be required under a Subtitle D-Plus program. Because of the potential similarity between Subtitle C-Minus and Subtitle D-Plus requirements, as well as broader Agency objectives, EPA believes that it may be appropriate to include consideration of the additional factors of state program development for mining and mineral processing waste streams, including federal program oversight, in order better to distinguish between these two regulatory scenarios.

Many states have recently or are currently expanding the scope and requirements of their regulatory programs as they apply to mineral processing wastes. For example, Florida has recently developed a policy that requires additional controls, such as liners, for new or expanded phosphogypsum stacks and is developing proposed regulations to update this policy and expand its scope to include phosphoric acid process wastewater. Missouri passed the Metallic Minerals Waste Management Act in 1989, and implementing regulations are being developed, which require permits, closure plans, maintenance plans, and provisions for financial assurance. Pennsylvania has proposed Residual Waste Regulations that, if promulgated, would require permits with provisions for liners, leachate collection systems, monitoring wells, and disposal of leachate for special wastes from iron and steel production and zinc slag (as well as other wastes). Similarly, Delaware, Ohio, and Tennessee have all recently developed revised solid waste regulations that will increase the stringency of requirements for management of special wastes. Some other states, such as Indiana and Kentucky, already have programs that specify management standards for mineral processing wastes.

In addition, some of these and many other states are currently working with EPA in the development of a regulatory program for mining wastes. This program is designed to be site-specific, risk based, and comprehensive. It also is being targeted to address the characteristics of mining wastes and site conditions at mining sites.

EPA believes that it may be appropriate to facilitate both development and maintenance of strong state programs and implementation of any federal regulations that may be necessary for mineral processing wastes by regulating all special wastes from mineral processing under Subtitle D of RCRA. Some mining and mineral processing wastes may be excluded from any further federal regulation under RCRA.

In light of these considerations, the results of Approach 2 indicate that it may be appropriate for the waste streams identified above for potential Subtitle C (full C or C-Minus) regulation not to be subject to

hazardous waste management standards, but instead to be retained within the Mining Waste Exclusion for mineral processing wastes. If such a finding is appropriate, EPA believes that it would need to be conditioned on the premise that major steps be taken to take near term actions to control releases from the facilities producing these waste streams. Some corrective measures are already being taken under a variety of Agency authorities (i.e., RCRA, Superfund, CWA) and more can and will be undertaken. EPA believes that the states must act to address the most immediate problems posed by these wastes, as well as any of the other mineral processing special wastes that have been found in this report to pose significant actual or potential hazard to human health or the environment. To assist in this effort, EPA would provide technical and other resource support to the involved states to improve their programs. If near term actions did not result in adequate control of such wastes, EPA would then take action to reconsider its regulatory determination and could designate certain waste streams as Subtitle C hazardous wastes.