4.0 BARRIERS TO INCREASED RMC SUBSTITUTION

This chapter addresses Part (B) of the Congressional mandate requiring EPA to "identify all barriers in procurement requirements to greater realization of energy savings and environmental benefits, including barriers resulting from exceptions from current law." The discussion groups these barriers into four major categories:

- Technical barriers;
- Legal, regulatory, and contractual barriers;
- Economic barriers; and
- Perceived Safety and health risk barriers

Several studies provide a discussion of barriers to increased RMC usage, especially as they apply to coal combustion products (CCPs).[66] Specifically, DOE published a report to Congress in 1994 entitled, *Barriers to the Increased Utilization of Coal Combustion/Desulfurization Byproducts by Governmental and Commercial Sectors* (DOE, 1994). The University of North Dakota Energy and Environmental Research Center (EERC) published an update to this report in 1998 (EERC, 1999). In addition, EPRI published a report in 1992 entitled, *Institutional Constraints to Coal Fly Ash Use in Construction* (EPRI, 1992). EPA prepared two reports to Congress on wastes from the combustion of fossil fuels, the first of which, published in 1988, addressed wastes generated from the combustion of coal by electric utility power plants. The second, published in 1999, addressed the remaining wastes not addressed in the 1988 report to Congress. More recently, the International Energy Agency (IEA) Clean Coal Centre published a report entitled *Cement and Concrete—Benefits and Barriers in Coal Ash Utilization* (IEA, 2005).

Building on these publications, EPA and PCA held a workshop in 2005 focused on alternative fuels and raw materials used in portland cement manufacture. During this workshop, participants discussed barriers to increased RMC usage in portland cement manufacturing. Materials discussed included steel slag, foundry sands, and CCPs (EPA, 2005b). In addition to these sources, EPA and PCA consulted cement manufacturers and trade associations to solicit their perspectives on potential barriers to increased RMC usage.

This section also incorporates additional information from research on individual state perspectives on CCP utilization. Specifically, EERC conducted state reviews addressing CCP utilization in Texas and Florida.[67] These state reviews reveal benefits associated with the use of CCPs, as well as barriers to increased use (EERC, 2005).

The following discussion contains selected excerpts from these documents, as well as industry perspectives to highlight barriers to increased RMC usage in Federally funded cement and concrete projects. Although some barriers have been reduced or eliminated since the publication of the reports identified above, a number of them still remain. Several of these barriers apply broadly to all RMCs; the discussion notes where barriers are specific to a particular material.

[66] This study also refers to CCPs as coal combustion byproducts (CCBs).
[67] Pennsylvania was the site of the third state review in December 2006. A synthesis report on the findings across the three states is forthcoming.

Finally, not all of these barriers equally affect the level of RMC reuse, nor are they equally amenable to being addressed by policy mechanisms within the immediate purview of EPA. For example, strong technical or economic barriers to the use of a particular RMC in a specific application are generally going to be less influenced by a policy intervention than a barrier related to lack of awareness or information concerning a particular RMC use.

4.1 Technical Barriers

Technical barriers to the increased beneficial use of RMCs include:

- Performance of products containing RMCs;
- Acceptance of materials specifications; and
- Consistency of RMC supply.

4.1.1 Performance of Products Containing RMCs

Product performance and quality concerns are known to prevent some potential RMC users from incorporating these materials into their portland cement or concrete products. These concerns may be related more to traditional terminology than actual performance. The term "recovered mineral content" refers to a material with a positive or beneficial use, regardless if the material was originally generated as a byproduct or waste. However, in many states, potential users and others appear to equate these materials with "wastes," that do not or cannot have the same quality attributable to a virgin or manufactured material (Goss, 2006). Most RMCs, however, when used properly, will preserve or enhance final product quality and durability.

Some specific concerns that have been identified include:

- Some states prohibit the use of coal fly ash or slag after a certain calendar date each year (e.g., October 15), based on the concern that when coal fly ash or slag is used during cold weather, it can slow the set and strength gain of concrete and hence delay the project schedule.[68] Conventional technologies, such as using a finer ground portland cement (Type III) or additional portland cement, accelerating admixtures, or using hot water for mixing could, in many cases overcome this concern, while maintaining the slag or coal fly ash content.

- Some state DOTs limit the use of coal fly ash or GBFS due to engineering considerations such as curing time and the impact of cold weather on construction, and due to concerns about the availability of the materials that meet strict product specifications.

[68] This belief of slowed setting and rates of strength gain when using coal fly ash and slag in cement are repeated by (Lobo, 2006).

- Use of GGBFS and coal fly ash at higher percent substitution rates for portland cement in concrete (greater than 50% for GGBFS and greater than 25% for coal fly ash) can reduce deicer salt scaling resistance (SCA, 2007).[69]

- Foundry sands are typically a fine material and might not be suitable for use in concrete unless blended with other sands. In addition, the presence of clay and contaminants in foundry sands may also limit reuse opportunities (Mullarky, 2006).

As discussed further in the following section on mechanisms to address these barriers, research, testing, and pilot programs are being conducted by various industry and governmental entities to identify proper standards and specifications for RMC use in concrete applications.

4.1.2 Acceptance of Materials Specifications

Some of the most significant technical barriers related to performance are rooted in specific material specifications and how they are (or are not) applied. For example, many state departments of transportation (DOTs) do not accept ASTM's performance specification for cement (C1157).[70] This is a technical determination made by state DOTs. Compounding this is a lack of harmonization between the AASHTO and ASTM specifications.[71] This leads to a lack of uniformity in the acceptance, specification, and utilization of RMCs among state DOTs.

4.1.3 Consistency of RMC Supply

One impediment to the increased use of coal fly ash in portland cement and concrete projects is the availability of required quantities of consistent, high-quality coal fly ash meeting the specifications for use in concrete (Mullarky, 2006). Different coal types produce different ashes, and an electric utility could switch among coal sources for various reasons (e.g., price, sulfur reduction) without consideration as to what this does to the ash characteristics. In addition, as discussed in Section 4.2.1, changes to air pollution control technology can affect the physical or chemical characteristics of RMCs. Lack of consistent quality of spent foundry sand is also likely to limit the development of its beneficial use market.

The state CCP reviews help shed light on this potential barrier. The Texas CCP review notes that CCP generators and ash marketers each have stringent quality assurance/quality control (QA/QC) protocols, yet the Texas Department of Transportation (TX DOT) and ready-mix producers indicated that coal fly ash storage capacity is limited, affecting users' ability to store consistent supplies, and the quality of coal fly ash on a truck-by-truck basis is not consistent. If there is a change in combustion operations, there is a resulting change in ash quality, making it

[69] Ongoing research at Iowa State University, sponsored by FHWA, several state DOTs, and industry is investigating the cause of scaling in GGBFS concrete.
[70] C1157-00 - Standard Performance Specification for Hydraulic Cement
[71] ASTM and AASHTO documents are now harmonized with respect to ASTM C 150 portland cement. However, AASHTO specifications as of this review do not include a performance cement specification analogous to ASTM C 1157.

difficult to produce a consistent product. In addition, TX DOT noted instances when coal fly ash was not available, even though it had been specified for a project.

The Florida CCP review also points out that producing a good-quality, consistent CCP is not easy when plant operators at the utilities have not made this outcome a priority. Some Florida electric utilities are using or are considering investing in beneficiation systems to produce concrete-grade coal fly ash, which will allow some coal fly ashes with high unburned carbon or ammonia content to meet ASTM C618 specifications for use in concrete.[72]

4.2 Legal, Regulatory Policy, and Contractual Barriers

Laws, regulations, and contractual policies may pose inadvertent barriers to increased use of RMCs. In this section, we consider a diverse set of influences, including the following:

- Air pollution regulations;
- State solid waste regulations;
- Bidding procedures and contractual constraints; and
- Barriers associated with CPG

4.2.1 Air Pollution Regulations

Industry stakeholders, State of Florida officials (EERC, 2006), and other state agencies have stated that regulatory programs for the control of mercury and nitrogen oxides (NOx) in electric utility air emissions can result in increased carbon levels in coal fly ash that impact the ability to use the ash as a supplementary cementitious material. The increased carbon levels result from the addition of activated carbon to control mercury emissions, and low temperature boilers to control NOx emissions which also result in increased levels of unburned carbon in the ash. Industry representatives understand that there are technology choices that would minimize these impacts on the beneficial use of coal fly ash. However, they indicate that the selection of air emission controls to meet state and federal requirements is very complex, resulting in industry solutions that will be unit-specific. Industry further indicates that, in many cases, some facilities may lose anywhere between $40/ton and $80/ton of coal fly ash (Hg-CCP dialogue mtg. summary Final Draft, 1/14/08) if they are no longer able to sell high carbon fly ash as a supplementary cementitious material in the manufacture of concrete. This estimate also includes the additional costs associated with the need to dispose of a formerly marketable by-product.

The Texas CCP review also notes that emissions control in the electric utility industry has had a subsequent impact on the type, quantity, and quality of the solid materials produced at a specific power plant (EERC, 2005). Officials indicate that the reduced supply of high quality coal fly ash already poses a threat to coal fly ash use in TX DOT projects, where high volumes of consistent quality coal fly ash are needed over the duration of large, long-term projects.

[72] One concern noted with respect to this consideration, however, is that any combustion facility associated with the use of carbon burnout (CBO) systems may be categorized by FDEP as a new NO_X source. If categorized in this manner, the installation of CBO systems may trigger New Source Review (NSR) requirements under the Prevention of Significant Deterioration provisions of the Clean Air Act.

EPA will continue to monitor the emission technologies the industry chooses to install and the impact on reuse potential. EPA believes that technology options are available to the industry, specifically for the application of NOx controls, which would minimize any impacts on the quality of fly ash. Technology solutions are being developed and deployed in the industry to minimize or avoid any such impacts from the use of mercury controls as well.

4.2.2 State Solid Waste Regulations

There are no uniform, national regulations for the beneficial use of recovered materials. Each state has its own regulatory program. Although many states are acting to facilitate the use of RMCs in concrete, some state solid waste regulations governing the management of RMCs may make it more difficult to beneficially use these materials. For example, in the Florida CCP review, some observers thought that state monitoring and other requirements were restricting beneficial use requests. In some cases, the Florida Department of Environmental Protection (FDEP) has required end users to install liners under temporary CCP storage areas as a precautionary measure. FDEP also requires the material to be covered. Additionally, there is hesitation from FDEP to allow CCP use in land applications, limiting the Florida Department of Transportation's ability to use it in road-building applications. The Florida review notes that some commenters viewed these requirements as unnecessary because they do not apply to comparable materials, or even to materials that interviewees considered to be of greater threat of environmental contamination, such as coal or limerock. CCPs are essentially being treated as a regulated solid waste by FDEP in this regard (EERC, 2005).

Experience with Florida's beneficial use application regulations further highlights the influence of solid waste regulation on the beneficial use of RMCs. The Florida CCP review notes that FDEP does not have a formal process for approving new beneficial use applications. Florida statutes generally define "solid waste" to include any discarded material resulting from domestic, industrial, commercial, mining, agricultural, or governmental operations. This includes CCPs. However, there is another provision in Florida's statutes that exempts certain materials from regulation as solid waste if:

1. A majority of the industrial byproducts are demonstrated to be sold, used, or reused within one year.

2. The industrial byproducts are not discharged, deposited, injected, dumped, spilled, leaked, or placed upon any land or water so that such industrial byproducts, or any constituent thereof, may enter other lands or be emitted into the air or discharged into any waters, including groundwater, or otherwise enter the environment, such that a threat of contamination in excess of applicable department standards and criteria is caused.

3. The industrial byproducts are not hazardous wastes as defined in the 2007 Florida Statutes (Title XXIX, Chapter 403, Part IV, and Section 703.)

Currently, FDEP does not have a rule implementing this section. Sometimes, FDEP points applicants to beneficial reuse guidance documents prepared for recovered screen material and waste-to-energy ash. Until a rule is promulgated, however, beneficial use projects are evaluated on a case-by-case basis. FDEP acknowledges that the current case-by-case approval procedure for CCP beneficial reuse is unclear.

Texas was also selected as a pilot state for an in-depth review of its CCP programs, policies, and use practices because of its progressive approach to CCP utilization and its support network to implement such activities. Although the Texas state review discussed barriers for all applications, we summarize only those specific to CCP use in portland cement and concrete:

- Virtually all of the utilities, ash marketers, and ready-mix producers mentioned attitude and education as key barriers. District and local highway personnel, architects, engineers, and contractors cited unfamiliarity, lack of knowledge, or unwarranted negative feelings toward CCPs as barriers to greater CCP utilization.

- CCP generators and ash marketers each have stringent quality assurance/quality control (QA/QC) protocols, yet TX DOT and ready-mix producers indicated that fly ash storage is limited, and the quality on a truck-by-truck basis is inconsistent. If there is a change on the combustion side, there is a resulting change in ash quality, making it difficult to produce a consistent product. In addition, TX DOT noted instances when coal fly ash was specified for a project, but was not available.

- By classifying CCPs as products, the material has the same advantages as all other recycled materials. However, liability lies primarily with generators and users because generators assume the responsibility of classifying the material in accordance with 30 Texas Administrative Code (TAC), Chapter 335.4, Subchapter R, and users take on the liability of using the material properly.

In addition to identifying existing impediments, the Texas state review identified several emerging issues that may affect CCP use in the future. These include new pollution control requirements (as discussed in Section 4.2.1) and the ability to retain institutional knowledge of CCPs as staff is turned over at the Texas Commission on Environmental Quality (TCEQ) and the Texas Department of Transportation.

4.2.3 Bidding Procedures and Contractual Constraints

Bidding procedures and contractual rigidities associated with procurement of portland cement and other RMC-related products may inadvertently constrain the use of RMCs. Industry sources note that contracts generally discourage changes in cement mix design. To counter these concerns and provide a consistent product, a contractor might default to a portland-only mix or one that contains less of the RMC (e.g., out of a concern for seasonal shortages of the RMC).

Contract specifications may force more competition among RMCs than necessary. Specifically, some specifiers (particularly some state DOTs) do not allow ternary mixtures (three-cementitious components) in concrete, so concrete is “forced” to use either coal fly ash or slag cement, if RMCs are to be used. However, ternary mixtures often provide performance benefits in concrete. Allowing ternary mixtures provides the possibility of using both coal fly ash and slag cement at significant rates in concrete, and also provides a way to replace greater levels of portland cement than just coal fly ash substitution alone. For instance, the Iowa DOT typically uses a mix of 15% coal fly ash and 20% slag cement; coal fly ash alone would likely not be used at a 35% replacement rate, but the two materials in combination works well for this DOT (SCA, 2007).

In some cases, the beneficial use of RMCs is constrained by the lack of familiarity with the RMC or preference for a well-known RMC, and these tendencies are reflected in procurement procedures. For example, specifiers often do not understand the difference between slag cement and coal fly ash. Since slag cement is generally a "newer" material in markets, these practitioners are often reluctant to allow slag substitution rates at their optimal level (up to 50% for pavements and up to 80% for mass concrete). They are more accustomed to coal fly ash substitution rates of 15% to 30%. This is reflected in a number of State DOT specifications that do not allow more than 25% slag cement (Arkansas, Illinois, Missouri, New York, and Vermont). SCA is working with FHWA to produce a users' manual for highway engineers about slag cement (SCA, 2007).

4.2.4 Barriers Associated With CPG

The CPG for cement and concrete require Federal agencies to give a procurement preference for recycled materials and products containing RMCs, when possible. However, a procuring agency might not always be able to purchase a CPG-designated item containing RMCs. RCRA Section 6002(c)(1) allows a procuring agency the flexibility not to purchase an EPA-designated item with recovered materials content. According to the statute, the decision not to procure such items must be based on a determination that such procurement items:

1. Are not available within a reasonable period of time;
2. Fail to meet the performance standards set forth in the applicable specifications;
3. Fail to meet the reasonable performance standards of the procuring agencies; or
4. Are only available at an unreasonable price.[73]

Over or inappropriate use of these exemptions could contribute to unnecessarily reduced RMC usage. Similarly, management inattention to the statutory procurement requirements could lead to failure to use RMCs.

4.3 Economic Barriers

Economic barriers to increased RMC utilization represent a key factor affecting the use of RMCs. The sections below present a brief discussion of the key economic barriers affecting increased RMC use. The following barriers are discussed:

[73] RCRA Section 6002, http://epa.gov/epaoswer/non-hw/procure/pdf/rcra-6002.pdf

- Transportation costs and geographic distribution;
- Importance of RMCs as a revenue stream;
- Cost-effectiveness; and,
- RMC disposal costs.

4.3.1 Transportation Costs and Geographic Distribution

RMCs are not necessarily generated in the vicinity of cement kilns or major construction projects or, in the case of foundry sands, are generated by a relatively large number of generators producing relatively small quantities. The costs of collecting and transporting these materials from their points of generation can render them uncompetitive with virgin materials at a specific site. For example, the ACAA notes that transportation costs are the primary economic impediment to the reuse of CCPs. ACAA estimates that such costs generally limit the shipment of CCPs to a 100-mile radius around a power plant. In addition to the problems posed by distance, using railcars to transport RMCs also presents issues because railcar availability is limited, and rail transportation rates are high in certain markets. This issue also applies to virgin materials; however, the geographic distribution and specific transportation costs are likely to vary from those for CCPs.[74]

Studies have noted the sub-optimal geographic location of RMC supplies, particularly coal fly ash and bottom ash. The best example of the lack of local availability is in California, where essentially no coal-fired power plants and no blast furnaces exist. However, depending on the size and scale of the project, the lack of proximate coal fly ash and related transportation costs may be overcome. For example, the large CalTrans Bay Bridge project imported coal fly ash from Washington and Wyoming, and the additional cost of transportation was minimal when compared to the entire project budget.[75]

As discussed in Section 4.1.3, different coals produce different ashes and an electric utility could switch among coal sources for various reasons (price, transportation costs, sulfur reduction, etc.) without consideration as to what this does to the ash. In an October 29, 2001, letter to EPA, DOE commented that “DOE sites have expressed concerns about the proposed concrete additives. An operations office in the western part of the country has stated…that cenospheres and silica fume additives for concrete may not be as readily available in all locations as EPA suggests” (DOE, 2001). This overbalance can be an impediment, as only certain areas of the country have access to RMCs, and transportation costs are too great to move the materials to areas with a relatively low supply of RMCs.

Likewise, slag granulation facilities are principally in the East, Midwest and South, so for adequate slag cement to reach more remote areas, like the West Coast, imports become essential. Bulk transportation over water is significantly less costly and energy intensive than transportation by highway or rail. Additional slag granulation facilities, if constructed in the

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[74] ACAA reports: As the value of coal fly ash has risen in the last two years, ash is typically trucked up to 100-150 miles without difficulty. Rail shipments have increased to more than 1200 miles.
[75] Personal communication with Tom Pyle, California Department of Transportation (CalTrans), August 30, 2007.

Midwest or East, would help improve the geographic distribution somewhat, but not to the Rocky Mountain or West Coast states (SCA, 2007).

In addition, seasonal factors can influence both the amount of RMCs produced (e.g., increased summer and winter power demands result in seasonal increased CCP production) and the demand for building materials (EPA, 2005b). Lack of product availability in certain markets can be a significant impediment to greater reuse. The shortage of coal fly ash in the Pacific Northwest in 2006 illustrates the impact of product non-availability. Construction specifications are prepared years in advance of construction. If an RMC is abundant, and included in the specification, but availability declines when construction starts, it may become a frustrating and costly problem for the contractor. Such an event could cause an agency to be cautious about including the RMC in future specifications.

The Texas state review (EERC, 2005) echoes the importance of transportation costs to the beneficial use of CCPs. In Texas, power plants are located in areas that are not heavily populated, so long distance transportation is necessary to get to major CCP markets. Some electric utilities also have limited infrastructure, making it difficult to transport their materials by anything other than by truck. In many instances, it is simply not economical to use CCPs due to these costs.

Finally, in relation to transportation costs and GGBFS distribution, foreign sources of RMCs can influence the reuse rate of domestic supplies. For example, the U.S. currently imports significant quantities of GGBFS from overseas because of low rates of slag granulation in the U.S., as well as that it is more economical on the West Coast to import GGBFS from the Far East than to ship it across the United States. (See further discussion below regarding the Cost of Increasing Slag Granulation Capacity.) Furthermore, bulk transportation over water is significantly less costly and energy intensive than transportation by highway or rail. Availability of foreign sources may enhance the economic disadvantage introduced by overland transportation costs.

4.3.2 Importance of RMCs as a Revenue Stream

The way in which utilities, and all RMC generators, account for costs is critical to RMC utilization (EERC, 1999). For example, for many utilities, the sale of CCPs is generally seen as merely a means of reducing operational costs through avoided disposal costs. When ash management is considered “an operational cost avoidance” rather than a revenue stream, the incentives for increased CCP utilization are reduced as compared to it being a source of revenue.

The market value of RMCs is critical to how a supplier views the management of these materials. For coal-fired electric utilities, the revenue produced by the sale of CCPs is often insignificant in relation to the revenue stream provided by the sale of electricity. The prices received for CCPs may be too low to justify a commitment to material marketing.

4.3.3 Cost-Effectiveness

The high price of some RMCs can be an impediment to their greater use. In a letter sent from DOE to EPA on October 29, 2001, a DOE northwest office advises that “…Unlike fly ash where the cost with or without fly ash is the same, including silica fume increases the cost by about $1 per pound. A typical [cubic] yard of concrete will use nearly 50 pounds of silica fume, which would increase the cost roughly 50%-65% for each [cubic] yard of concrete used" (DOE, 2005b).[76]

It is noteworthy, however, that RMCs with high unit prices (e.g., GGBFS and silica fume) also can have high reuse rates. Therefore, high prices may often be a reflection of the high inherent value that some of these materials have as portland cement and concrete additives.

It should also be noted that some individual foundries may choose to engage in a partnership with an intermediary as a cost-effective way to market and sell its spent foundry sand. The costs to market the sand may be higher than the firm is willing to spend and will look to a middleman to conduct the sales transactions. If the costs of selling were lower, or if the selling price were higher, the foundries may be more willing to handle the process themselves.

Finally, slag granulation in the U.S. affects the cost-effectiveness of this material for use as an RMC. The slag granulation rate in the U.S. is considerably lower than other industrialized nations. In the U.S., only 25% of slag is granulated, while in Europe and Japan, nearly 80% of blast furnace slag is granulated. Several reasons for the low U.S. granulation rate exist, including uncertainty and consolidation in the steel industry; capital cost of installing granulation/grinding facilities; and availability of foreign slag granules (SCA, 2007).

4.3.4 RMC Disposal Costs

The relatively low cost of disposal tends to discourage the expanded use of many RMCs in cement and concrete. Disposal costs are a function of available disposal sites. For Electric Utilities, as part of the permitting process for any new facility or upgrade to an existing facility, the permit must describe what is anticipated for any waste or byproduct streams. Existing plants typically have sites near the plant for disposal, if needed. They may be owned by the utility (most common) or nearby, such as a locally managed landfill (not necessarily a municipal solid waste landfill), most likely a monofill. Given the nature of privately-owned and industrial waste landfills, total available capacity at these sites is uncertain. However, according to the National Solid Wastes Management Association, as of November 2006 there were approximately 1,654 Subtitle D landfills operating in the 48 contiguous states.[77] Furthermore, on a national level, the current municipal solid waste landfills have 20 years worth of disposal capacity available.

For many RMC generators, the market value of the material does not make up for the handling, processing, and marketing costs of selling the material for beneficial use. Current beneficial use

[76] SFA indicates that "the primary impression of silica fume as a raw material and silica fume concrete in general is that 'silica fume is quite expensive' and as a concrete 'more difficult' and 'costly' to finish as compared to concrete containing no silica fume. This industry impression as an expensive material has limited the use of silica fume and is the primary obstacle to further expanding the use of silica fume in concrete" (Kojundic, 12/13/2006). (Note: USGS reports that further use of silica fume is primarily limited by the inelastic supply of silica fume, as a result of the relatively inelastic global supply of silicon metal and ferrosilicon and related ferroalloys production. (Personal communication with Hendrik van Oss, USGS, July 12, 2007.))

[77] National Solid Wastes Management Association, November 8, 2006, "MSW (Subtitle D) Landfills." Available at: http://wastec.isproductions.net/webmodules/webarticles/anmviewer.asp?a=1127

programs from states, Associations, and EPA are helping to expand the beneficial use of these materials. However, as long as it is more economical to dispose of the RMCs in land disposal units than to use them beneficially or to sell them as a marketable product, use rates will likely be limited.

4.4 Perceived Safety and Health Risk Barriers

Another barrier to the expanded beneficial use of RMCs concerns the safety and health risks – real or perceived – associated with these materials, i.e., the environmental risks associated with exposure to these industrial materials if they enter the environment through leaching into soil or other pathways. The issue of risk continues to be evaluated by the Agency. However, targeted risk analyses conducted to-date indicate that risks associated with the identified RMCs in cement and concrete are likely to be insignificant. For example, in the Agency's May 2000 Regulatory Determination for fossil fuel combustion wastes, EPA's risk evaluation of the beneficial use of CCPs in cement and concrete concluded that national regulation under the Resource Conservation and Recovery Act (RCRA) is not warranted.[78] This final Regulatory Determination additionally notes a previous Regulatory Determination in 1993 (see 58 FR 42466; August 9, 1993), an EPA-proposed risk-based set of standards for CKD (see 64 FR 45632; August 20, 1999), and an unpublished report as of May 22, 2000 from the National Academy of Sciences presenting "a comprehensive review of mercury and recommendations on appropriate adverse health effects levels for this constituent." Additional research concerning steel slag includes a study conducted by Deborah M. Proctor, et al.: "Assessment of Human Health and Ecological Risks Posed by the Uses of Steel-Industry Slags in the Environment," 2002. *Human and Ecological Risk Assessment* Vol. 8, No. 4, pp. 681-711.

Findings from these analyses did not identify significant risks to human health and the environment associated with the beneficial uses of concern. In addition, we identified no documents providing evidence of damage to human health and the environment from these beneficial uses. Our overall conclusions from these efforts, therefore, are that encapsulated applications, including cement and concrete uses, appear to present minimal risk.

EPA has also supported risk analyses associated with the beneficial use of foundry sand. The Agency concluded that the use of foundry sand as a substitute for natural silica sand in making clinker, as a substitute for natural sand in cement, or in other uses in concrete manufacture, appears to present minimal risk to human health and the environment.

[78] http://www.epa.gov/epaoswer/other/fossil/ff2f-fr.pdf