Sedimental Journey

Reckoning Progress Across Millennia

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Sediment beneath the nation's waterways is polluted from industrial, mining, agricultural, construction, and natural processes. Whatever has gone into our waterways—from sources we can identify to those we cannot—is likely to be in our sediment.

From prevention to material handling, including where to put and process sediment, the tasks required to deal with contaminated sediment are far from the ordinary. For one thing, the makeup of materials in sediment is extremely varied. Moreover, sediment differs from air, water, and even soil. Thus, transfer of cleanup technologies is less direct than one might expect.

Nevertheless, advances are being made toward rendering sediment both safe and usable. Indeed, sediment is increasingly being recognized as a significant, cost-effective, sustainable natural resource. More uses are being found for all sediment, including sand, silt, and clay; mixtures of these three; and these three mixed with contaminants of many kinds. As uses for sediment increase, however, a number of key questions must be addressed.

Key Questions

Will it be easy to use sediments of various kinds? Use of sediment—both contaminated and clean—is becoming easier as new methods evolve. A first priority is to find ways of proving what we think will work. In this regard, science must lead, but science must work with those who can use the end products.

Why should never-polluted sediment be included in the effort to make contaminated sediment safe and useful? A primary reason is that clean sediment is a natural resource that has been overlooked. As the search continues for uses of contaminated sediment, low-tech, cost-effective processes for making products from many kinds of sediment are emerging. Another reason, discussed in the next section, is that uses of clean and contaminated sediment overlap. Still another reason is that buyers want to choose from products made with different materials, and sediment can provide a good product line. Sometimes sediment will offer a tailored design that suits customer needs better than conventional materials. In addition, many sites have both clean and contaminated sediment nearby.

Who will make buying decisions? Increasingly, the user or project manager determines which sediment products have commercial value, though science should play a central role in this regard. The private sector generally believes sediment processing will be market driven, and scientists must work to meet the needs of users. Yet the public sector is beginning to emphasize the idea that processing decisions should involve better communication between scientists and project managers in different agencies. Either way, the emphasis must be on use and user, with specific sites and needs in mind. Decision makers will vary, but they must include users.

Do uses of sediment change with cleanliness level? Some believe the degree of cleanliness should be determined by the intended use—another argument for considering the full spectrum of sediment. For example, cleanliness criteria for playground materials are likely to differ from those for surface-mine reclamation material.

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Overlapping Uses of Clean and Contaminated Sediment

Processed sediment is the accepted term for sediment that has been processed so that it is environmentally safe. Nationwide, organizations such as the Army Corps of Engineers, the Environmental Protection Agency, national laboratories, state agencies, and universities, as well as the private sector, have joined in research aimed at deriving sediment that is environmentally and structurally safe.

Until recently, the focus was on thermal, chemical, and biological processes for decontaminating sediment. These methods remain extremely important, and the search will continue for economical, effective decontamination technologies that can be used throughout the process chain, from cleanup to commercialization. Today, however, there is increasing acceptance of processes that make contaminated sediment environmentally safe, but do not decontaminate per se. Several processes prevent contaminants from leaching and volatilizing above acceptable levels.

There is also emerging awareness that processed sediment can help solve other environmental problems. Some examples are (1) mixing sediment with fly ash and injecting the blend into abandoned mines to prevent acid-mine drainage into groundwater and streams, (2) capping contaminated soils on brownfields to prevent leaching, (3) engineering wetlands to filter leachates from landfills on waterways, and (4) making sediment-based products that control riparian erosion. Other processes that prevent contaminants from being available to the environment have potential uses ranging from landfill cover to commemorative parks and gardens. It is also possible to engineer blends, some of which include minerals that absorb specific metals, for manufactured soils and fill (see below). With and without blends, it is possible to create wetlands engineered to hold contaminants in place during passive remediation.

With regard to *clean sediment,* it has long been known that sediment could be more widely used. For example, sediment in some locations is high in plant nutrition. By and large, however, except for mining aggregates, sand, and occasionally clay, there has been little attention to large-scale commercialization of sediment. Now, partly as a result of the search for low-cost processed sediment, sites and situations are being identified in which clean-sediment products appear to be more valuable, on several levels, than products made from conventional materials.

One example is manufactured soil. Several cities—Toledo, Ohio; Jacksonville, Florida; and Mobile, Alabama—are in various stages of planning and demonstrating the commercial viability of manufactured soils for such applications as parks, golf courses, greenhouses, and bagged product for resale to landscapers. Also, manufactured soils are expected to be used for dynamic remediation of brownfields, which are often abandoned, contaminated, unsightly industrial sites on potentially valuable waterfront property. In Pittsburgh on the Monongahela River, for example, a densely compacted 200-foot-deep, 200-acre slag dump is slated for the development of 1,000 high-end family units, despite the fact that virtually nothing grows on the barren, porous slag. The estimated 700,000 tons of soil needed will be expensive and may not support root systems. The contracted design-engineering firm has decided it wants to experiment with sediment, and a nearby source of clean sediment is expected when a lock on the Monongahela River is removed. If the strategy is successful, significant savings are expected.

Bricks are another example. Until recently, research on making bricks from sediment has been hampered by the fact that organics cause structural deterioration during baking. However, at least one firm has applied nonthermal processes and has a successful record of making bricks and cast products of many kinds that meet ASTM and other standards for homes, noise and security walls, erosion control, and artificial reefs. Various costs, including production, labor, and energy, appear to be lower than those of making and using baked bricks, concrete blocks, and comparable products.

Thus there is growing evidence that both processed and clean sediment can do as good a job—often a better job—and perhaps at lower cost than products made from conventional materials. Two key concepts are emerging in this regard. The first is *producing products for performance.* On the Pittsburgh slag site, for example, blended soils produced with scientific know-how may lead to better-performing product than topsoil. The second is *engineering products for specific uses.* For instance, using the cast process, custom- or mass-produced products made with sediment—such as articulated blocks for specific soil-erosion-control projects, bricks and blocks for buildings with high-energy-efficiency specifications, and monoliths for noise reduction—may be engineered to meet specific needs better than conventional products. Such customer-first concepts should be achievable with varied products from a range of sediment, including contaminated sediment.

Buyers, including materials specialists and specifiers, must know that there is a general willingness to work with their needs. To this end, six key criteria must be met:

- *Price* must be no more than that paid for conventional materials.
- *Quality* must be as good as or better than that of alternative materials.
- *Risk* must not be a concern.
- *Standards, support, scientific seals of safety, sufficient supply, satisfied schedules,* and *sound economics* must be integrated.
- *Testing* must be completed; in general, the customer cannot be expected to pay for proof of product.
- *Usefulness* must be determined from the customer's point of view.

There are criteria to meet the needs of other stakeholders as well. For example, Army Corps of Engineers District Offices cannot exceed their budgets, ports need to dredge specific volumes, and investors need adequate supplies to manufacture products. Cost criteria are often shared. For example, all stakeholders will want supply located near demand when possible, transport via water when feasible, and affordable processes to produce needed end products.

Sediment volume has been a negative. The nation dredges more than 400 million cubic yards of sediment annually. Sediment is usually pushed aside to silt back into (obstruct) navigable channels. Or it may be placed in contained disposal facilities, which in some regions are full to crisis levels. Now dredging cannot be done because sediment is contaminated. The point is that volume can be a positive, provided there is demand, and demand can be developed, in part because sediment can often be engineered to perform better than conventional materials or products at competitive cost.

How can demand for sediment be fostered? First, now that processes for the use of sediment are being developed, potential-use sites and decision makers need to be matched with supply. Second, funding is needed for demonstrations to prove that products will work at potential locations; to this end, scientists must work with users and site managers. Third, it is necessary to understand marketing and other forces that determine workability.

Conclusion

The land beneath the nation's waterways offers vast quantities of resources waiting to be improved, used, and valued. The first steps toward utilizing these resources are being taken with the development of safe, workable, cost-effective products made with sediment. Given a focus on both the end user and the specific end use, both clean and contaminated (processed) sediment are beginning to offer more useful and cost-effective solutions than conventional materials of the past.

Schools in Alabama and Georgia Receive Waterways CD-ROM

The Coosa-Alabama River Improvement Association (CARIA) has distributed a CD-ROM describing the inland waterways system of the United States to the libraries of junior and senior public and private high schools in Alabama and Floyd County, Georgia. The CD, called *A Digital Reference Library,* uses graphics, charts, photographs, and text to describe the physical characteristics, development, function, history, and benefits of the nation's 25,000 miles of navigable waterways. Special emphasis is given to the development of navigation on the Alabama River; the role of the Coosa River in waterway development; and the history of CARIA, which established a goal of educating the public on the benefits of the nation's inland waterways.

The CARIA CD-ROM is a useful reference for anyone interested in the inland waterways system of the United States. It is a Windows program easily navigated with a click of the computer mouse. The user can branch out to any file within the program by using an index or by pulling one of the seven "books" off the shelf. Unique graphics depict, for example, how a navigation lock works, the cargo and fuel efficiencies of barge transportation, the community water cycle, and the hydrologic cycle. The user can also access such information as a description of the dredging process, the role played by water in our daily lives, a discussion of non-point-source pollution and ways to reduce its effects, and a depiction of tonnage moved through the Port of Mobile and on the Alabama River. Other files hold data and photos on each dam and reservoir within the Alabama-Coosa-Tallapoosa River Basin.

CARIA was formed in 1890 and has been instrumental in securing support for major water projects on both the Coosa and Alabama Rivers. Its mission is to promote the improvement of the Alabama-Coosa-Tallapoosa River Basin through education and promotion of the basin's many aspects, including navigation, recreation, power production, economic development, water supply, flood control, and environmental quality.