[A Solid Approach: Decreased Processing of Metal-Impacted Soil and Waste]

By Derek Pizarro

Soil pre-treatment utilizing metal recovery is not necessarily cost effective. Pre-treatment remedial approaches dating back to the mid 1980's were unsuccessful in reducing overall project costs—cost to process and treat the material outweighed the cost of hazardous disposal.

Hazardous disposal also made sense to most responsible stakeholders when dealing with the removal of site soil. It satisfied many private and corporate entities proximal to the impacted area. Nevertheless, the largest single cost associated with a remedial environmental metal treatment project still remains hazardous disposal.

In an effort to reduce landfill costs, consultants turned to treatment methodologies that removed and recovered metal pieces or fragments from the soil or waste matrix. However, these processes are time consuming, machinery expensive to maintain and operate, and rarely recoup the cost of their process via recycling. More recently, advancements in metals treatment techniques associated amendments and treatment operations have changed remedial approaches and costing.

Amendment dosages have declined with improvement in reactivity, purity, and safety, while costs of raw material and production of these products have remained relatively stable versus inflation. More mechanical processes are automated, efficient, and less labor-intensive. Separation and mixing equipment has become portable and reliable.

Despite advancements regarding mechanical soil treatment, physical separation of metal from soil is still a large cost when treating soil for disposal or onsite reuse. By eliminating or reducing physical separation during chemical stabilization, and also considering metal particle sizing in both the bidding and work plan development stages, costs and onsite time can be reduced significantly.

Most importantly, surface area of the metal contaminant, naturally and/or after mechanical processing, still remains a large factor in dosage and cost of treatment amendments. Here are three metal removal and/or recovery steps that can be eliminated completely.

1. Stop Screening/Separating Materials

Eliminating mechanical, pneumatic or hydraulic techniques for separation of metal from a soil matrix can save time and costs regarding mobilization, stockpiling and processing, separated soil and metal management, and demobilization.

Screening material is to separate various particle sizes, e.g. gravel, from soil. Separating material involves removal of a target particle size(s) or objects, e.g. bullets, from the soil matrix. Separation in almost all cases involves some form of screening as a preceding step to separation. Hydraulic separation utilizes water to separate soil from, generally, finer metal contaminant particles. Pneumatic separation involves a blower to blow lighter soil particles out of the process stream, leaving behind the heavier, larger pieces of metal.

Regardless of mechanical process, all of these methods add time, cost, and additional health hazards to the project scope. For purposes of comparison, Table 1 depicts costs at a typical gun range assuming a soil berm of 5,000 tons of soil to treat with backsplash starting to occur during normal use. Compared to hazardous disposal, separation and treatment saved about 22% in onsite costs, treating soil without separation of bullets saved nearly 65%.

Table 1 – Missouri Military Gun Range – costs per ton of soil, extrapolated

Scenario	Excavation & Mixing	Separation	Soil Amendment	Haz Disposal	Non-Haz Disposal		Recovered Metal	Cost per Ton of Soil
Soil	$25	-	-	$250	-		-	$275
Soil	$50	$120	$11	-	$35		$2	$214
Soil + Bullet	$50	-	$12	-	$35		-	$97

From a site health and safety (H&S) standpoint, pneumatic separation of metals from soil can raise contaminated dust issues with workers and near-site populations. The pneumatic separation process, even with an efficient bag-house and containment unit can still generate fugitive particulates that escape the dust management system. While respirators are appropriate for site personnel, metal-impregnated fine soil (e.g. dust) can migrate offsite.

Regarding soil washing, cost and time aside – both increased treatment costs – the process still results with some residual metals in soil. Additionally, the process water is impacted with metal targeted for removal; that water has to be managed and disposed of appropriately. Also, sometimes it may not be possible to remove lead via mechanical separation due to the fine nature of the lead particles in the soil matrix – too difficult or expensive to recover and manage.

With advances in treatment amendments that also maintain low dosage rates, it is production savvy and cost efficient to not consider metal removal and recycling from the impacted soil matrix, see Table 2. Effectively, comparing the same product applied to the same site soil, with and without bullets left in the soil matrix, amendment dosage adjustment was either unnecessary or only had to be raised one percent to achieve comparable treatment results.

Table 2 – Missouri Military Gun Range – Treatability Test

Sample Name	EnviroBlend® Dosage		Screening Leaching Test Results			
	Chemical	Percentage	Pretest pH	Solution	Final pH	Lead mg/L
Soil (18g)	Untreated	-	1.82	TCLP 1	4.91	13.0
	EnviroBlend®	3.0%	-	TCLP 1	8.09	0.088
Soil+ Bullet (20g)	EnviroBlend®	4.0%	-	TCLP 1	9.54	0.30

2. Evaluate Particle Size

There is no definitive recommendation for the interplay between treatment costs for heavy metals-impacted soil and the decision to reduce contaminant particle size or not. Table 2 cites two instances where it fiscally made sense to utilize the described method of particle management. Note, in some instances, landfill restrictions may dictate that metal fragment or contaminant size be reduced to meet intake requirements.

Reduce. A site consisted of large fragments of lead-impregnated glass from a former manufacturing facility intermixed with soil and industrial scrap; arsenic and cadmium were contaminates of concern as well. A consistent soil/waste matrix was viewed as essential to expeditious treatment and disposal. Certain parcels of the site had large pockets of glass in-situ – glass fragments did not have enough, nor a consistent, matrix for product addition.

Without increasing the overall porosity of the soil and waste matrix, there was not an efficient way to add enough treatment amendment to treat the lead glass. The decision was made to grind the existing glass and metal fragments with site soil in a pug mill. Uniformity of the matrix allowed a single product and dosage rate to be utilized.

Despite exponentially increasing the surface area of lead glass, potentially increasing leachability, the increased surface area added additional pore space in the soil/glass matrix in which to add treatment amendment, enough that it would meet TCLP and SPLP criteria prior to disposal. Even with this higher surface area, the soil amendment dosage was still just three percent weight to weight addition.

Leave-As-Is. For some sites, it may make more sense to not alter the size of metal fragments or particles in the site soil. At a complex and prominent site in Cincinnati, Ohio, the consultant considered amendment addition and particle reduction, via crushing or milling, of metal and waste fragments. Yet, separation or milling of onsite metal fragments prior to treatment amendment was judged less cost effective compared to straight hazardous disposal.

As an alternative, the consultant evaluated a low-dosage of treatment amendment that would provide treatability of site soils in their current state. The final remedy was to apply soil treatment product via agricultural spreader and mix with an agricultural tiller. This decision saved the client $1 million versus hazardous disposal, even more savings would have been realized compared to modification of matrix, treatment, and disposal as non-hazardous.

3. Simple Changes Net Massive Savings

In an industry where methods of implementation and treatment historically evolve slowly, the emphasis is to not redraw approaches to conceptual site treatment; rather, simple modifications to currently available and viable solutions are recommended. Additional machinery, more manpower, increased removal, and further excavation are not the answer to site environmental solutions. Less site work is more return on investment.

Significant cost-savings and reduced liability were realized by the remedial environmental industry when onsite reuse received expanded regulatory acceptance; now, treating and leaving onsite soil that contains pieces or fragments of metal is becoming commonplace. By reducing mechanical processes and lowering dosages rates of treatment amendments, similar magnitudes of project cost savings can be realized while still preserving outlaid goals of treatment, regardless of final cradle for the waste.

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