

ENVIRONMENTAL BIO-SYSTEMS, INC.

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COLD MIX ASPHALT TREATMENT OF SEWER SLUDGES AND CONTAMINATED SOILS AND RIVER SEDIMENTS

Contaminants Treated:

- **Heavy Metal (chromium, Cr(VI), lead, cadmium, arsenic, etc.);**
- **Petroleum hydrocarbons (gasoline, diesel, fuel oil, kerosene, crude oil and others);**
- **Chlorinated Solvents (PCE, TCE, DCA, others); and**
- **Organics and humus-rich sludges.**

INTRODUCTION

Environmental Bio-Systems, Inc. (EBS) has summarized Cold Mixed Asphalt (CMA) as an economically attractive method for stabilizing sewer sludges, contaminated soils and river sediments using the Cold Mixed Asphalt process. Cold-mix asphalt batching is not a new remedial technology. It has been used successfully at various sites at hundreds of sites throughout the United States. By using an environmental cleanup technology known as *cold-mix asphalt batching*, the U.S. Air Force Center for Environmental Excellence (AFCEE) is looking to recycle contaminated soils into a safe, useful product following federal and state standards.

COLD MIX ASPHALT PROCESS

Extensive pre-treatment bench testing by EBS assures that the contaminants will not leach out of the asphalt. The CMA process uses large pug mills for soil mixing with loaders/backhoes to bring the sludge, soil or sediments into the hopper of the pug mill. Then after the oil emulsion is added to the mixture and the media is treated, the loader places the cold mix asphalt into a storage area. The CMA can be used in about 48 hours. It can be stored for about 6 months or more. The oil emulsion keeps the hydrocarbons, solvents, organics (up to 90%) and heavy metals bound up in the oil. Once the asphalt is used, the contaminants stay in the asphalt and will not leach out. Decades later, after the asphalt is used, the asphalt is removed from the road or parking lot surface as inert, asphalt and transported as a non-hazardous material to the landfill. The hydrocarbons, solvents, organics and metals will stay bound up with the oil.

COLD MIXED ASPHALT CASE STUDIES

Stephen M. Testa, P.G., C.E.G., an engineering geologist and an expert on the CMA process wrote a book about *Reuse and Recycling of Contaminated Soils* for CRC Press. In the book, Mr. Testa includes dozens of case studies for the CMA process, the hot asphalt process and other cement-related processes. The CMA case studies are primarily in southern California where numerous large oil refineries in Los Angeles used CMA to take their oily sludges from around the base of their oil storage tanks. This oily sludge was processed into CMA and recycled

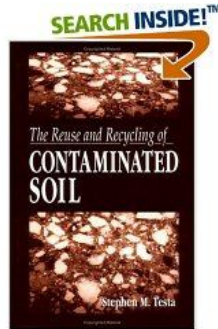
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(reused) as the surfacing for secondary containment berms around the above ground tanks (see book case studies). Stephen M. Testa is available as a technical advisor, on an as-needed basis.



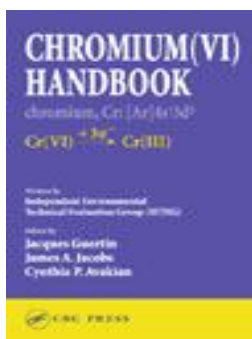
The handbook for the CMA process with contaminated soils, sewer treatment plant and industrial process sludges, and river sediments by Stephen M. Testa.

BENCH TESTS

EBS performs the CMA bench testing (leaching tests), design of the CMA field chemistry, as well as the design of the equipment for the field work. Depending on the level of testing, EBS will design and implement leachability tests. The tests can relate to just the CMA process, or other solidification processes.

FIELD SUPERVISOR AND PROJECT MANAGER

James A. Jacobs, P.G., C.H.G. is the EBS Chief Hydrogeologist with over 25 years of experience in assessment and in-situ remediation of soil and groundwater impacted by PCE, TCE, heavy metals including Cr(VI), arsenic and lead and petroleum hydrocarbons (TPH-g, TPH-d, BTEX, MtBE, TBA). He is a lecturer and three-time Fulbright award winner in environmental engineering. He is certified as a Hydrogeologist in California and registered as a geologist in California, Arizona, Oregon, Washington, Alaska and several other states, he has co-edited and co-authored two CRC Press books: *The Chromium (VI) Handbook* (784 pages, 2005), and a book about MTBE in 2000. He has written over 100 technical articles or abstracts. Mr. Jacobs is usually the on-site supervisor of major remediation projects. He has undergraduate and graduate degrees in geology.



The handbook for chromium [Cr(VI)] remediation edited by Jacques Guertin, James Jacobs and Cynthia Avakian.

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CHIEF CHEMIST

Jacques Guertin, Ph.D., is Chief Chemist. He has a Ph.D. from McMaster University in Hamilton, Ontario. He also has degrees from the University of Montreal. He designs bench scale tests. He has 35 years of experience in laboratory chemistry and teaching. He is a coauthor of two books, including *The Chromium (VI) Handbook*, and author of 90 technical publications on chemistry and science. Dr. Guertin holds 5 U.S. patents.

EBS has included this public information on the Cold Mixed Asphalt Process:

Fact Sheet #99-05 July 1999; (From **MADEP (Massachusetts Department of Environmental Protection)**)

Cold Mix Asphalt Batching

The purpose of this fact sheet is to describe cold-mix asphalt batching – a technology that has been and will be used in the future to treat low-level contaminated soil on-base from several sites in California, Massachusetts and many other states.

The purpose of this fact sheet is to answer questions regarding cold-mix asphalt batching as a method of soil cleanup and to provide information on the technology. This fact sheet addresses:

- Background information about the use of cold-mix asphalt batching
- One regulatory agency's guidelines (Massachusetts Department of Environmental Protection's (DEP's)) regarding cold-mix asphalt batching
- Steps taken in risk reduction and safety
- The cold-mix batching process
- Technology analyses (advantages vs. disadvantages)
- Community involvement opportunities

Words that appear in *italics* are defined in the glossary at the end of this fact sheet. This fact sheet is an update to a previously published one (#98-16 in October 1998).

Introduction

Increased environmental awareness during the past 20 years has led to many societal changes. Restoring natural resources that have been contaminated is one such change. Recycling used materials, rather than simply placing them in landfills, is another.

Cold-mix asphalt batching incorporates low-level contaminated soils into paving material with the addition of a heated emulsion at less than 120°F. The process is regulated by the Massachusetts Department of Environmental Protection (DEP) and the final product is used

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statewide as a base under asphalt paved surfaces. The subgrade material is capped with 1 to 2 inches of asphalt cover for durability and to limit infiltration of water. Therefore, the asphalt-batched material is not exposed directly to traffic and elements.

Background

The MMR environmental cleanup is overseen primarily by the United States Environmental Protection Agency (EPA) under the terms and conditions of the Comprehensive Environmental Response, Compensation and Liability Act, or CERCLA, the law which established the Superfund program.

The U.S. Air Force Center for Environmental Excellence (AFCEE) has followed federal regulations to investigate areas of suspected soil contamination at MMR, screen alternatives, develop the proposed cleanup plans, and gather public input before selecting a final remedy. For several areas of contamination at MMR, AFCEE, in conjunction with MassDEP and EPA, developed a *Record of Decision (ROD)* identifying cold-mix asphalt batching as the selected cleanup technology.

Asphalt batching must meet state guidelines. According to state law, contaminated soils generated in Massachusetts shall not be disposed of at a landfill if a feasible alternative exists (see *Code of Massachusetts Regulations (CFR) 310 40.0032 (5)*). Recycling contaminated soils containing certain types and quantities of contaminants into an asphalt paving material has been considered a feasible and preferred alternative to landfilling for many years. AFCEE will work with MassDEP to satisfy the necessary permit conditions to perform on-site cold-mix asphalt batching. Further, MassDEP will be able to inspect the on-site batching operation at any time. Recycling contaminated soil through cold-mix asphalt batching also meets the federal criterion to demonstrate a preference for treatment over landfilling.

Risk Reduction and Safety

AFCEE understands the public concerns that have been expressed regarding the use of cold-mix asphalt batching as a remedial technology for cleaning up low-level contaminated soils. There are various ways that AFCEE is addressing these concerns to be protective of the environment and to ensure the safety of workers and the public. These management procedures are described briefly below. Potential risks associated with cold-mix asphalt batching are identified and evaluated by examining:

- Contaminants processed and concentrations of the contaminants (see also Batching Process),
- Potential pathways and exposure of the contaminants to humans and plants and animals (receptors),
- Materials used in the process (see also Batching Process).

The soils proposed for asphalt batching contain relatively low levels of *volatile organic compounds (VOCs)*, *semi-volatile organic compounds (SVOCs)* and metals. VOCs are chemicals

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that are commonly found in gasoline and solvents that can be used for degreasing and readily evaporate to the atmosphere.

Because the cold-mix process does not involve the excessive heating of soils (less than 120°F), air emissions are expected to very limited, if any. Although air emissions are unlikely, AFCEE will conduct air monitoring. These procedures will help to minimize the potential risk of exposure to workers and the public beyond the on-base plant.

AFCEE will conduct an air monitoring program for dust and chemical vapor emissions. This monitoring will include real-time readings and more sensitive methods that require laboratory analysis. If at any time air monitoring reveals that safe levels are exceeded, work will be stopped immediately. Emergency equipment shutdown mechanisms will be specified in the equipment design and operation procedures and through worker training.

Workers at the site will be trained properly and provided with necessary tools for protection while operating equipment and managing the wastes. At a minimum, they will comply with Occupational Safety and Health Administration (OSHA) requirements.

Workers will keep soils damp, cover stockpiled soil and take all other appropriate and necessary precautions to reduce dust and vapor emissions. Standard spill-control equipment and procedures will be used. Local fire departments will be notified, in advance, of all activities and materials used. A fire prevention plan will be in effect; fire extinguishers will be on hand and all site personnel will be trained in their use.

Batching Process

All the soils recycled by cold-mix asphalt batching at MMR must fall within the levels previously established by the DEP. The soils earmarked for asphalt batching are generally located within two feet of ground surface, where human, plant and animal exposure is most likely to occur. In the few instances where contaminants are located at greater depth, AFCEE plans to treat soils in place with soil vapor extraction (SVE) or other appropriate technology.

Most of the soils tested at MMR fall within the acceptable criteria for cold-mix asphalt batching. However, soils not meeting the state criteria will be excavated, contained, and transported safely to a licensed hazardous waste treatment facility for final disposal (see flow chart on pg. 3). Off-site disposal and treatment of all contaminated soils was evaluated and determined to be not as cost-effective as on-site asphalt batching. Further off-site disposal does not meet CERCLA preference to conduct treatment and/or disposal on site.

Prior to the cold-mix batching process, low-level contaminated soils will be tested at EPA-approved laboratories to ensure that they meet Massachusetts soil recycling criteria (see the following table).

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Massachusetts Soil Recycling Facility Summary Levels ^a	
Contaminant	Allowable contaminant levels (mg/kg or parts per million (ppm))
Total Arsenic (As)	30
Total Cadmium (Cd)	30
Total Chromium (Cr)	500
Total Mercury (Hg)	10
Total Lead (Pb)	1,000
Total VOCs (dry weight)	30 to 1,800 ^b
Total Petroleum Hydrocarbons (TPH)	5,000 to 60,000 ^c
Total PCBs	<2
Total Halogenated Volatile Organic Compounds	5
Listed or Characteristic Hazardous Waste (TCLP ^d)	None

Notes: Concentrations of other contaminants, not listed in this table, must meet *MADEP S-1/GW-1 standards*.

^a Contaminant levels presented in the table are a summary of allowable contaminant levels in soil recycling permits issued by the DEP's Division of Hazardous Waste as of April 1994. For a complete listing of allowable contaminant levels for a specific facility, please consult the applicable facility permit.

^b and ^c Each permitted VOC level is process-specific and permitted levels should be verified with the facility's individual soil recycling permit.

^d TCLP testing should be performed for metals or organic compounds when the total concentrations in the soil are above the theoretical levels at which the TCLP criteria may be met or exceeded.

In addition, soils will be examined to determine their suitability for asphalt batching. MassDEP Policy Document #94-400 ("Interim Remediation Waste Management Policy for Petroleum Contaminated Soils" #WSC-94-400, April, 1994) lists maximum concentrations of contaminants

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in soil that can be used in asphalt batching. With fine-grain soil, a higher percentage of asphalt emulsion is required to coat the particles. Occasionally, the soil may be pre-treated prior to asphalt batching to stabilize *inorganic* material in the soil. For example, soils with potentially leachable concentrations of lead can be pre-treated and stabilized using blends of cement and fly ash. Licensed vendors must receive authorization from the MassDEP to use their proprietary fixatives or asphalt emulsifiers.

Soils from MMR that meet the MassDEP criteria for asphalt batching will be brought to the on-base processing location. The soil storage locations will be bermed or diked to prevent run-off of any chemical constituents. The soils will be loaded into a hopper in a controlled manner for conveyance to a mixing chamber where they will be wetted or treated with anti-dust agents to prevent dust emissions. An asphalt emulsion, delivered from a tanker truck, will be applied to the soils using rotating blades inside an enclosed device known as a *pugmill*. The temperature of the emulsion is generally 100°F to 120°F. Gravel will be added to the soil emulsion mix inside the pugmill to further stabilize the asphalt paving material. The material then will be removed from the pugmill, stockpiled, and covered for curing which lasts from 48 to 72 hours. Curing is a hardening or solidifying process that binds contaminants to the asphalt and prevents contaminant evaporation and leaching. After curing, the material can be used on MMR as subgrade for use in roadways or parking facilities.

Before the final product is used, AFCEE is required to conduct leachability testing using EPA's *Toxicity Characteristic Leaching Procedure (TCLP)* to ensure the contaminants are bound and will not be released over time. Test samples of the material will be placed in an acidic solution and agitated over time. This is intended to simulate long-term exposure to natural weather conditions. Bardon Trimount, a Stoughton, MA firm has asphalt batched over 650,000 cubic yards of contaminated soil. In eight years of leachability testing, no contaminant leaching from batched asphalt has been detected.

Cold mix asphalt batching relies on electrical power. If power to the asphalt batching process stops, stockpiles of the contaminated soil ready for processing will be covered until power is restored, in order to minimize dust/VOC emissions. The MMR and local fire departments will be briefed on the asphalt batching process and equipment prior to the commencement of operations.

A Common Solution

Asphalt batching is a common method for recycling contaminated soil with proper handling. It creates a safe, useful product from minimally contaminated material. Hundreds of thousands of tons of contaminated soil at hundreds of sites have been treated nationwide using on-site cold mix asphalt batching. State and federal environmental regulators consider batched asphalt to be stabilized completely and do not require any further tracking of the material. In fact, on-site cold mix asphalt batching was used successfully at the MMR for treating approximately 4,000 cubic yards of contaminated soils associated with the *Drainage Structure Removal Program (DSRP)* in 1995-1996. Asphalt batching products have been used on roads throughout MMR,

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Massachusetts and the United States.

Technology Analyses

Advantages: The principal advantages of cold mix asphalt batching are:

- It keeps contaminated soil out of landfills.
- The final product is a beneficially useful material.
- The process is fast (up to 650 cubic yards/day);
- The price is cost competitive.
- It minimizes transportation of contaminated soils, and associated VOCs and particulate emissions by on-site treatment.

Disadvantages:

- Stockpiled material awaiting treatment must be covered.
- Extensive testing is required to determine the exact percentage of emulsion in the mix.

Conclusion

Cold-mix asphalt batching provides a proven recycling method for low-level contaminated soils. This recycling technology is proven and has been used effectively on the MMR and several towns across Cape Cod and Massachusetts.

The location of the on-base processing plant will be chosen based on factors such as distance from on-base/off-base housing, and proximity to all areas where excavation is scheduled to occur.

Asphalt batching is a recycling technology that has been approved by federal and state regulatory agencies. It satisfies several of the federal guidelines for selecting a remedial action because it provides reduction of contaminant mobility, uses resource recovery/alternative treatment technology and is cost effective. In addition, AFCEE will have helped clean up part of MMR's natural environment while recycling (rather than landfilling) low-level contaminated soils. Lastly, all of the asphalt-batched material is to be used on the MMR to help restore damaged roads.

Community Involvement

Community involvement during the decision-making and implementation periods is critical for a successful cleanup program. The public will be notified of the start-up, progress, and completion of work on sites and at the asphalt batching plant. Similar community involvement activities will continue as plans to use asphalt batching are developed. Public meetings with regulators, individuals, residents, and workers will be held.

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Glossary

cold mix—A process by which contaminated soils are bound chemically without excessive heat (less than 120°F)

drainage structure removal program—A comprehensive program to identify, characterize, and remove underground drainage structures, sumps, and associated soils at various sites across MMR.

emulsion—A combination of asphalt cement and surfactants (e.g. dishwashing liquids, or other proprietary structured or complex fluids) that is used to stabilize contaminants in soil.

inorganic—Material not containing the element carbon (e.g. metals such as iron).

MADEP (Massachusetts Department of Environmental Protection) S-1/GW-1 standards—Conservative risk based cleanup standards for soil and groundwater established by the Commonwealth of Massachusetts.

pugmill—A revolving drum used for mixing.

semivolatile organic compounds (SVOCs)—Organic chemical compounds that do not evaporate readily to the atmosphere.

record of decision (ROD)—A final decision for either a source area or groundwater plume that may or may not involve remedial action based upon previous investigations and public/regulatory input.

TCLP—(Toxicity Characteristic Leaching Procedure). Testing procedure to determine whether certain levels of hazardous materials leach from waste or processed wastes.

volatile organic compounds (VOCs)—Organic chemical compounds that evaporate readily to the atmosphere.

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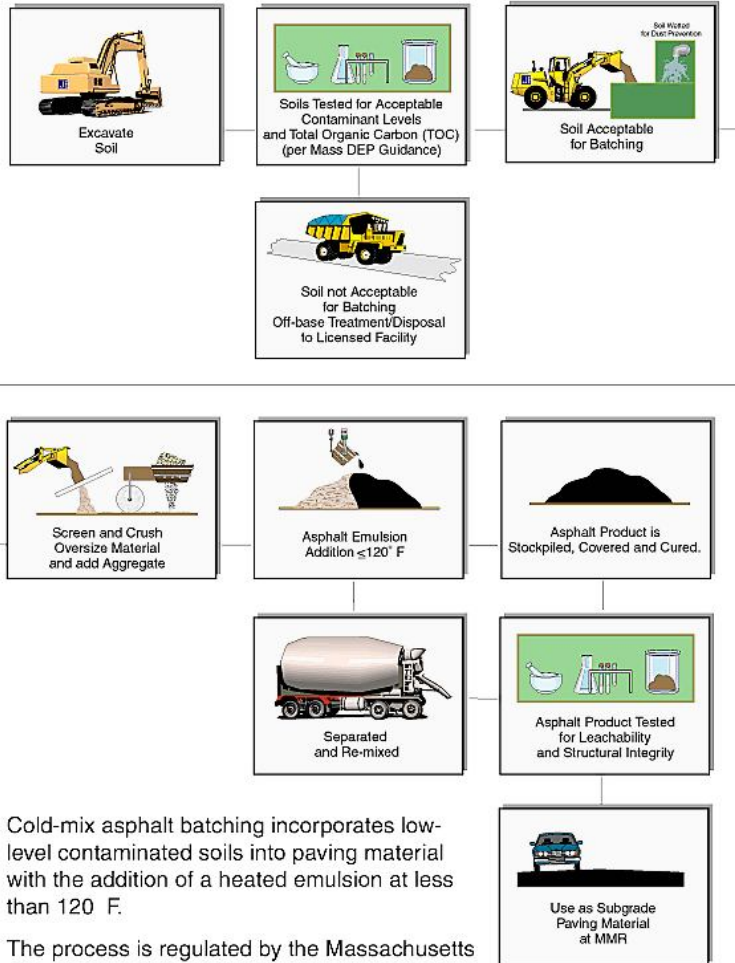
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On-Base Cold-Mix Asphalt Batching Process Flow Chart

Start Here



Cold-mix asphalt batching incorporates low-level contaminated soils into paving material with the addition of a heated emulsion at less than 120 F.

The process is regulated by the Massachusetts Department of Environmental Protection (DEP) and the final product is used statewide as a base under asphalt paved surfaces.

The subgrade material is capped with 1 to 2 inches of asphalt cover for durability and to limit infiltration of water.