COST AND PERFORMANCE REPORT

Solvent Extraction/Dechlorination at the
New Bedford Harbor Superfund Site,
New Bedford, Massachusetts

November 2000

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Technology Innovation Office

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Summary Information [1,2,3,4,5,8]

The New Bedford Harbor Superfund Site (NBH) is located along the northwestern shore of Buzzards Bay in New Bedford Massachusetts, approximately 55 miles south of Boston. From the 1940s to 1978, two manufacturing facilities located along the New Bedford Harbor, the Aerovox facility and the Cornell-Dubilier electronics facility, discharged polychlorinated biphenyl (PCB)-contaminated wastewater from industrial operations onto the shoreline and into the harbor. During investigations of the site performed by EPA in the late 1970s, widespread PCB contamination was found in sediments and marine life throughout the 18,000 acres of estuary, harbor, and bay areas. In September 1979, the Massachusetts Department of Public Health (MDPH) closed major fishing areas within the harbor. In August 1982, EPA began a remedial investigation (RI) of the site. Sediments were found to be contaminated with PCBs, polycyclic aromatic hydrocarbons (PAHs), and heavy metals including lead, cadmium, copper, and chromium. The site was listed on the National Priorities List in September 1983.

Figure 1 shows a general layout of the NBH area. The NBH site has been divided into three operable units (OU) - Upper and Lower Harbors (OU1), 5-acre Hot Spot Area (OU2), and the Outer Harbor (OU3). EPA has performed RIs at OU1 and OU2; an RI has not yet been performed at OU3. PCB concentrations in OU1 were found to range from below detection levels to 4,000 mg/kg, while concentrations in the OU2 Hot Spot Area ranged from 4,000 mg/kg to more than 200,000 mg/kg. This report addresses the cleanup of OU2.

The Record of Decision (ROD) for OU2 was signed in April 1990 and specified source control measures that included dredging of PCB contaminated sediments from the Hot Spot area followed by incineration. The ROD specified that dredging would occur at depths of up to four feet to remove sediments with PCB concentrations of 4,000 mg/kg or higher. Dredging of about 15,000 cubic yards (18,000 tons) of sediment from the Hot Spot area was completed in the fall of 1995, with the dredged sediment temporarily stored in a Confined Disposal Facility (CDF) located along the New Bedford shoreline at the end of Sawyer Street. The CDF is a three cell, double-lined (high density polyethylene) holding pond that was planned to be used for staging sediments prior to incineration. However, due to local and congressional opposition to incineration, EPA postponed the incineration component of the Hot Spot remedy to explore alternative treatment technologies. In 1995, EPA issued an Explanation of Significant Difference to address interim storage of the Hot Spot sediments at the CDF. The CDF is covered with a 10-millimeter permalon cover.

EPA evaluated four technologies as possible alternatives to incineration of the Hot Spot sediments - solvent extraction/dechlorination, vitrification, thermal desorption/gas phase chemical reduction, and solidification/stabilization. Pilot-scale testing was performed for the first three technologies and bench-scale testing was performed for solidification/stabilization. Testing was conducted at the 8-acre NBH Sawyer Street location which includes the CDF, a test pad, a water treatment building, and a laboratory (see Figure 2). This report addresses the results of the pilot-scale study of the solvent extraction/dechlorination technology. Reports about the other technologies tested are available at www.frtr.gov/cost.

Figure 1. Site Location Map [1]

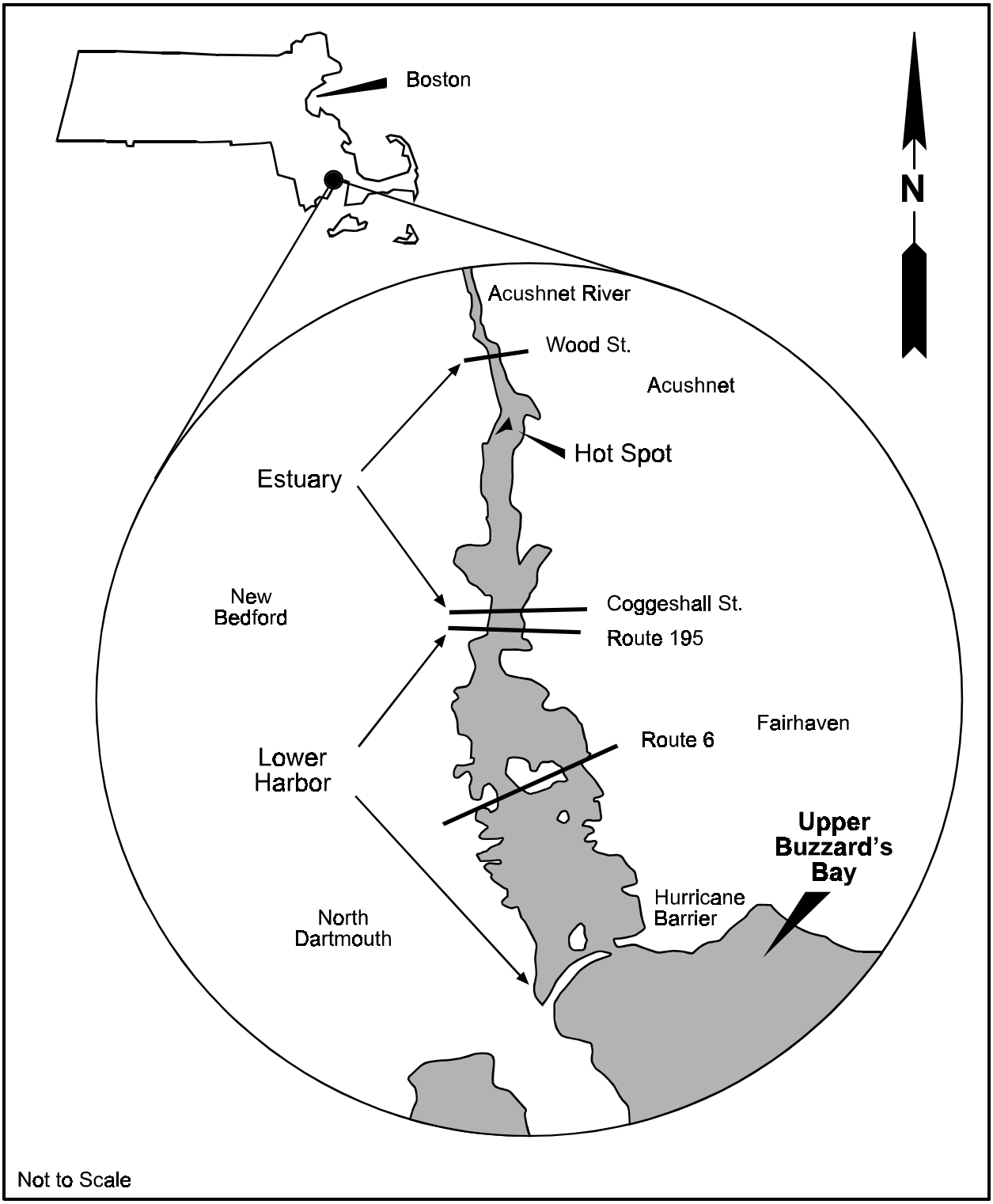
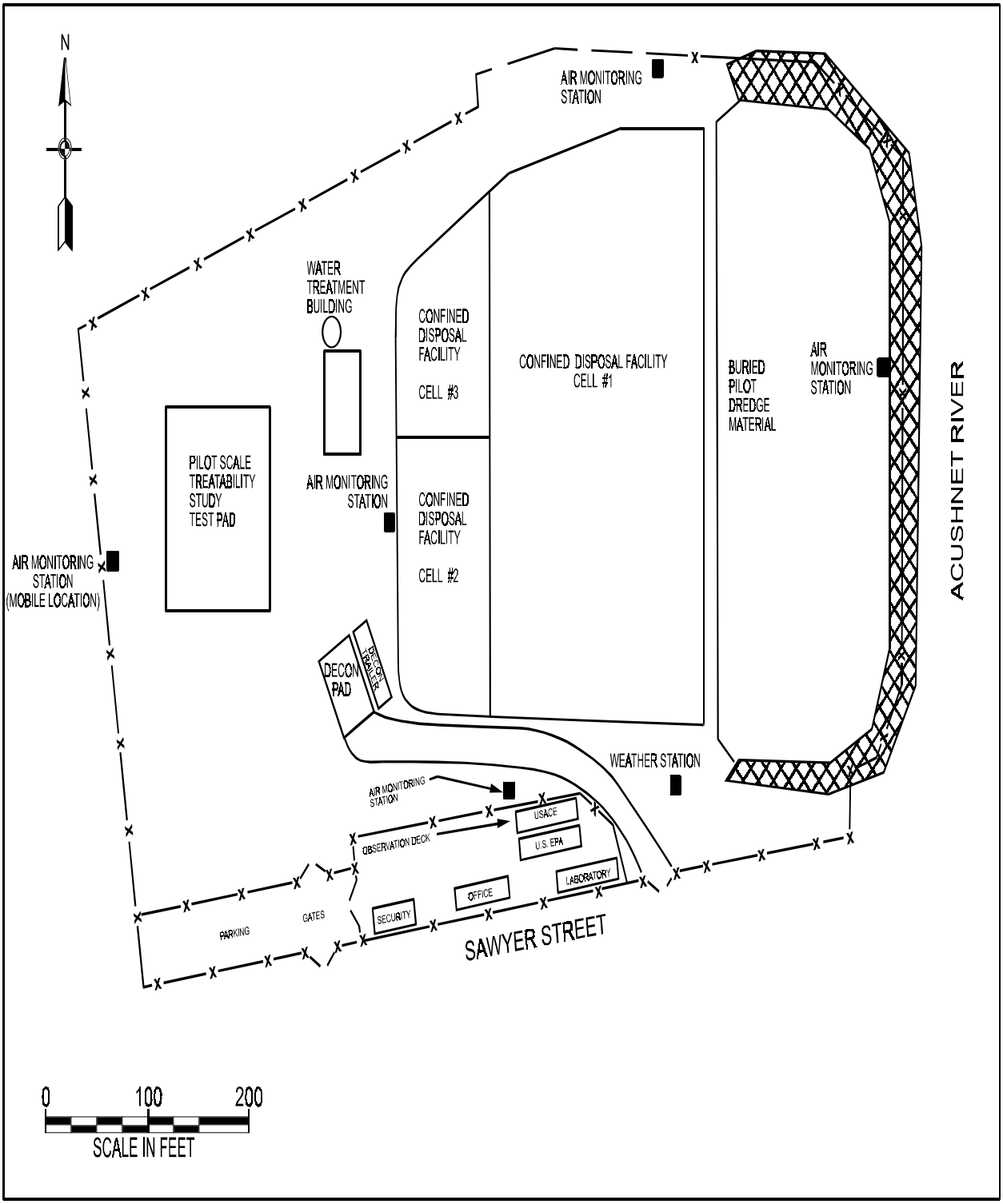


Figure 2. Layout of Confined Disposal Facility and Test Area [1]



According to the EPA RPM, none of the four technologies tested have been implemented for OU2 because of lack of community support for the use of on-site technologies to remediate the Hot Spot sediments. As a result, the ROD for OU2 was amended in April 1999 to specify dewatering of the sediments on-site and transporting them off-site, without further treatment, to a Toxic Substances Control Act (TSCA) permitted landfill.

Factors That Affected Cost or Performance of Treatment [1,3]

The sediment used in the pilot-scale demonstration was from the Hot Spot area of New Bedford Harbor, which had been dredged in 1995. PCB concentrations in the sediments in the Hot Spot area ranged from 4,000 to more than 200,000 mg/kg.

Matrix Characteristics [1,3]

Listed below are the key matrix characteristics for this technology and the values measured for each based on sediment samples collected in June 1995 from the CDF and from pilot study feed sediments.

Parameter	Value
Soil Classification	Fine sandy silt with some clay-sized particles present
Clay Content and/or Particle Size	50 - 70% of sediment passing a number 200 sieve; sediment contains some small shell fragments (pass through a 1-inch screen)
pH	Not provided
Moisture Content	50% by weight
Total organic carbon	7% (average)
Density	1.2 tons/cubic yard (wet unit weight)
Oil and Grease	CDF representative sample: 22,000 - 34,000 mg/kg Pilot study feed: 11,700 - 36,900 mg/kg

Treatment Technology Description [1,6,7]

Ionics Resources Conservation Company (RCC) and Commodore Advanced Sciences Inc. (Commodore), formerly Commodore Remediation Technologies, Inc (CRTI), conducted a pilot-scale test of a solvent extraction/dechlorination process on the Hot Spot sediments. The test involved two processes - the patented Ionics RCC Basic Extractive Sludge Treatment (B.E.S.T.®) solvent extraction process to remove contaminants from the sediments, followed by the Commodore Solvated Electron Technology (SET®) process to treat the high concentration PCB oil from the B.E.S.T.® process. The Ionics RCC B.E.S.T.® process and the Commodore SET® process used in the pilot test is shown in Figure 3 and described below.

Ionics RCC B.E.S.T. ® Process Description

The B.E.S.T.® process shown in Figure 3 included feed material preparation, extraction, solids drying, and solvent recovery, with diisopropylamine (DIPA) used as the solvent for the test. The major process steps are summarized in Table 1.

Figure 3. Solvent Extraction/Dechlorination [1]

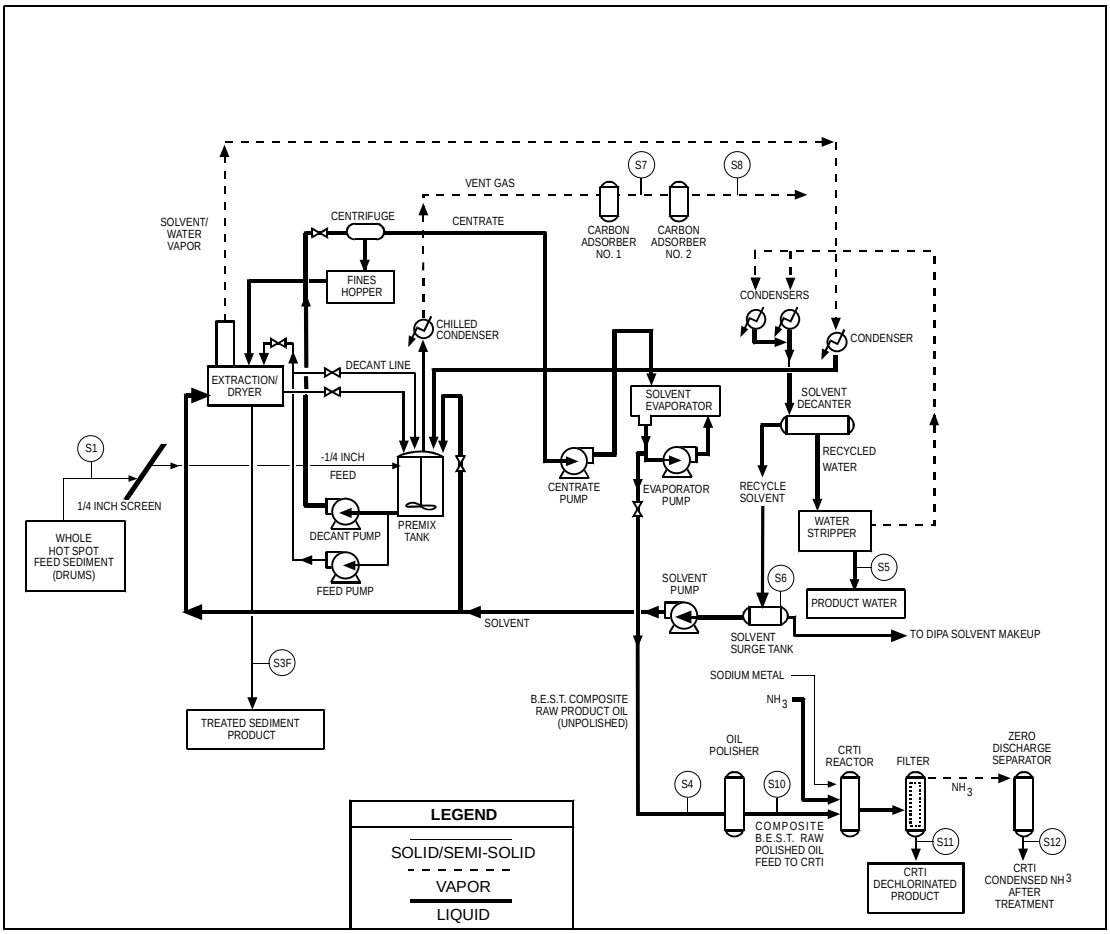


Table 1 - Key Steps in the B.E.S.T.® Process [1]

Process Step	Description
Feed material preparation	Hot Spot sediment from the CDF was screened to remove oversize materials (greater than 1/4 inch). The screened material was then homogenized and stored in 5-gallon buckets. Oversize materials were returned to the CDF.
Extraction	Screened sediments were fed into a Premix Tank, where solvent was added and mixed with the sediments for several minutes. The mixture was then allowed to separate. The extract solution was decanted from the solids and sent to the Solvent Recovery Process (see below). If needed, the extract solution was sent through a centrifuge to remove fines, prior to being sent to solvent recovery. Settled solids were removed from the tank and sent to the Solids Drying Process (described below).
Solvent Recovery:	The solution from the Extraction process was sent to the Solvent Recovery process which involved (1) using a solvent evaporator to separate the organic fraction (oil and solvent) from the aqueous fraction and to recover solvent and water from the aqueous fraction; and (2) using an oil polishing unit to recover the solvent from the oil and further concentrate the oil fraction.
Solvent and Water Recovery	In the solvent evaporator, the extract solution was heated to its boiling point and evaporated, forming a solvent/water azeotrope (vapor) and an organic fraction. The organic fraction was sent to the oil polishing unit. The vapor was condensed, then sent to the solvent decanter to separate the water and solvent phases. Recovered solvent was sent to a storage tank for reuse in the process; recovered water (containing about 5% solvent) was sent to the Solvent/Water separation process (see below) to recover residual solvent.
Oil Polishing	In the oil polishing unit, the organic was first heated with indirect steam to evaporate the solvent and to concentrate the oil. Steam stripping was then used to remove residual solvent. Solvent vapors from the oil polishing unit were routed back to the solvent evaporator. The concentrated oil was then pumped to the SET® process for treatment of PCBs.
Solids Drying	Solids removed from the Premix Tank during the Extraction process were sent to the Extractor/Dryer Condenser unit to remove solvent. Indirect heat was used first to drive off the bulk of the solvents; steam stripping was then used to remove residual solvent. Solvent vapor was routed back to the Solvent Recovery process. Treated solids were collected and stored.
Solvent/Water Separation	Recovered water (containing about 5% solvent) from the Solvent Recovery process was sent to the Solvent/Water Separation process to recover residual solvent. Steam stripping was used to separate the solvent from the water. Solvent vapors were condensed and the recovered solvent sent to a storage tank for reuse in the process. The water was stored for reuse or disposal (after sampling).

Commodore SET® Process Description

The SET® process uses an alkali metal (calcium or sodium) dissolved in liquid anhydrous ammonia to generate a solvated electron solution. This solution is a strong reducing agent that treats PCBs by removing the chlorine atoms from the PCB molecule (dechlorination). By-products of the process include metals salts, high molecular weight hydrocarbons, and trace amounts of ammonia. Ammonia is recovered for reuse in the system.

A mobile SET® unit with a one gallon per day processing capacity was used for the pilot study to treat the concentrated PCB oil fraction from the B.E.S.T.® process (described above). As shown in Figure 3, the concentrated oil was sent to a reactor vessel where it was mixed with liquid anhydrous ammonia. Metallic sodium was then added to the reactor, generating the solvated electron solution to reduce the PCBs. The reaction required about 15 minutes to complete the dechlorination of the PCBs. The by-products included sodium chloride, high molecular weight hydrocarbons, and trace amounts of ammonia. The solution was then sent to the Zero Discharge Separator vessel, where ammonia was separated from the treated organic material. The ammonia was then sent to Ammonia Recovery to separate ammonia from water; the ammonia was reused in the process. The treated organic material was manually removed from the separator for testing.

Operation [1]

Pilot study testing of the solvent extraction/dechlorination process was divided into two types of tests - optimization testing to identify the optimum process parameters required to maximize extraction of PCBs from the sediment, and verification testing to collect data from the process operating under optimal conditions. The type of testing performed is summarized in Table 2.

Ionics RCC performed five extraction runs (three optimization and two verification) and two oil polishing runs [one optimization (OP), one verification (VP)]. The extraction runs were operated in a batch mode except for one run (E-2) which was operated in a continuous mode. Oil product from runs E-1 to E-3 were combined and used in test run OP1. Oil product from runs E-4 to E-5 were combined and used in run VP1.

Commodore performed seven runs - four optimization tests using the product from the OP1 test as feed material and three verification tests using the product from the VP1 test as feed material. All runs were in batch mode.

Table 2 - Pilot Test Schedule for B.E.S.T.® and SET® Processes [1]

Test Date	Day	B.E.S.T.® Batch Number	SET® Batch Number	Test Description
6/6/96	1	E1	-	Extraction optimization run
6/7/96	2	E1	-	Extraction optimization run
6/8/96	3	E2	-	Extraction optimization run

Table 2 - Pilot Test Schedule for B.E.S.T® and SET® Processes [1] (continued)

Test Date	Day	B.E.S.T.® Batch Number	SET® Batch Number	Test Description
6/9/96	4	E2	-	Extraction optimization run
6/10/96	5	E3	-	Extraction optimization run
6/11/96	6	E3	-	Extraction optimization run
6/12/96	7	OP1	-	Oil polishing optimization run
6/13/96	8	OP1	-	Oil polishing optimization run
6/14/96	9	E4	-	Extraction verification run
6/15/96	10	E4	C1	Extraction verification run/SET® optimization
6/16/96	11	E4	C2	Extraction verification run/SET® optimization
6/17/96	12	E5	C3	Extraction verification run/SET® optimization
6/18/96	13	E5	-	Extraction verification
6/19/96	14	VP1	C4	Oil polishing verification run/SET® optimization
6/20/96	15	VP1	-	Oil polishing verification run/SET® optimization
6/21/96	16	-	C5	SET® verification
6/22/96	17	-	C6	SET® verification
6/23/96	18	-	C7	SET® verification

B.E.S.T.® OptimizationTesting

The optimization testing of the B.E.S.T.® process was performed as follows:

Batch E-1 - Feed sample load was 130 pounds. Three cold (<27°C) extraction cycles were used. Optimum extraction time was 5-15 minutes (first and last cycles). Solids-free extract, no centrifugation needed.

Batch E-2 - Feed sample load was 132 pounds. Processed in continuous mode to allow fines carryover to centrifuge.

Batch E-3 - Feed sample load was 124 pounds. Three cold extraction cycles were used. Optimum extraction time was 5-30 minutes (first and last cycles). Solids-free extract, no centrifugation needed.

Batch OP1 - Solvent/organic solution in the solvent evaporator was concentrated to about 30 liters and pumped to the oil polisher. The concentrated organic fraction from the oil polisher was sampled and placed in a container for treatment with SET®.

B.E.S.T.® Verification Testing

Based on the results of the optimization tests, the following parameters were used for verification testing.

Parameter	Value
Feed rate	140 pounds
Number of Extraction Cycles*	10
Extraction temperature	<27°C for first extraction, then increase temperature with each extraction to 55°C for extractions 7-10
Extraction mixing times	10 minutes for extraction cycles 1-3; 15 minutes for extraction cycles 4-10
Settling time	30 minutes for extraction cycles 1-3; <15 minutes for cycles 4 through 10
Centrifuge	Not used

* The optimization testing results did not define the number of extraction cycles to use. Based on other available screening data, Ionics determined that a significant amount of PCBs were removed after eight cycles. Ten extraction cycles were used for verification testing to collect additional data on the efficiency of the process at lower PCB concentrations.

SET® Optimization Testing

The concentrated oil (organic fraction) from the B.E.S.T.® process tests was used as the feed for the SET® optimization testing. The oil exiting the oil polishing unit of the B.E.S.T.® process was a warm liquid. However, after cooling, the liquid solidified to a waxy solid that could not be pumped. The SET® unit was modified to receive solids through a side access port. The four parameters optimized were sodium mass, ammonia volume, premix time, and treatment time.

Sodium mass - the first optimization run was made using a high dosage of sodium (80% by weight) to the mass of material treated. During the second and third optimization runs, the sodium to feed material ratio was lowered to 50% and 40%, respectively. However, the treated material from the later runs contained higher levels of PCBs than expected. As a result, the ratio was increased to 65% for the verification testing. A post-treatment step was added to react the excess sodium metal.

Ammonia volume - the first optimization run determined that the ammonia volume required was between 8 and 9 liters.

Premix time - the first optimization run determined that approximately 10 minutes was sufficient to completely slurry the feed material into the ammonia prior to sodium addition.

Treatment time - the optimal time for the reaction was determined to be 20 minutes.

In addition, it was determined that during the second and third optimization runs, untreated material was inadvertently becoming dislodged from the feed mechanism and re-contaminating treated materials as it was being transferred from the reactor to the zero discharge holding vessel. During the first three optimization runs, treated material was quenched in the reactor vessel (stopping the reaction). The process operation was then modified so that the treated material was not quenched until after transfer to the zero discharge holding vessel. This allowed the reaction to continue during transfer operations, such that any inadvertent contamination would be treated.

SET® Verification Testing

Verification testing was performed using three batches of concentrated organic fraction (oil) from the B.E.S.T.® process - 606 grams, 619 grams, and 646 grams. As discussed above, the organic fraction was a waxy solid that was chopped into small pieces to insert into the reactor vessel. The reactor was filled with anhydrous ammonia. After a 10 minute premix period, sodium was added at a 65% by weight ratio of sodium to feed material. The mixture was reacted for 20 minutes, then discharged to the zero discharge vessel for ammonia removal. After ammonia recovery was complete, one liter of quench water was added to react with any residual sodium. The treated material and water were removed from the vessel and stored in 5-gallon plastic pails.

Performance Information [1,2,6,7]

The objectives of the pilot study included evaluating the effectiveness of solvent extraction followed by dechlorination in treating PCBs and heavy metals in the Hot Spot sediments, identifying potential environmental or engineering constraints related to the use of the technology to remediate sediments, and evaluating scale-up to full-scale operation. The target treatment goal for PCBs was 50 mg/kg, based on the Toxic Substances Control Act (TSCA) disposal requirements for PCB-contaminated dredged soil. The target treatment goal for metals were the Resource Conservation and Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) criteria. In addition, Federal and State air regulations required air monitoring for on-site technologies that have the potential to generate polychlorinated dibenzo-p-dioxins (dioxins or PCDD) and dibenzofurans (PCDF), reported as total PCDD/PDCF and as the toxicity equivalent quotient (TEQ), calculated based on EPA toxicity equivalent factors.

B.E.S.T.® Performance

Data on the performance of the B.E.S.T.® process are presented in Table 3 for the solvent extraction step and in Table 4 for the oil polishing step.

Solvent Extraction

Table 3 presents data on PCB concentrations in the feed sediment (S1), in sediment samples collected from the Premix Tank between extraction cycles (S3), and in the final treated sediment (S3F) from the solvent extraction process, as well as the calculated PCB removal efficiency. Data on oil and grease, total solids, and DIPA concentrations in the treated sediment (S3F) are presented in Table 4.

Table 3 - PCB Concentrations in Treated Sediments for B.E.S.T.® Process Testing [1]

Parameter (Sample Location)	Optimization Testing PCB Concentrations (mg/kg)			Verification Testing PCB Concentrations (mg/kg)	
	E1	E2	E3	E4	E5
Feed Sediment (S1)	2,100	2,500	2,500	2,360	2,515
Extraction Cycles (S3)					
1st Extraction	NS	790	290	3,700	680
2nd Extraction	NS	910	55	2,000	780
3rd Extraction	NS	310	36	780	430
4th Extraction	41	140	23	87	120
5th Extraction	220	68	24	40	39
6th Extraction	5.1	160	50	22	14
7th Extraction	3.9	55	7.5	6.3	8.2
8th Extraction	13	19	NS	5.2	7.1
9th Extraction	NS	NS	NS	2.8	4.2
10th Extraction	NS	NS	NS	4.8	6.0
Final Treated Sediment (S3F)*	13	19	7.5	4.8	6.0
Removal efficiency (%)**	99.38	99.24	99.70	99.79	99.76

NS - Not sampled
* Samples collected after eight extractions for optimization testing and afer 10 extractions for verification testing
** PCB concentration in feed sediment (S1) minus PCB concentration in final treated sediment (S3) divided by PCB concentration in feed sediment (S1) x 100

As shown in Table 3, the concentrations of PCBs in the final treated sediment ranged from 4.8 mg/kg to 19 mg/kg, which was less than the target of 50 mg/kg. A majority of the PCBs were removed from the sediment after three to four extractions. For example, in run E5, PCB concentrations were reduced from 2,515 mg/kg in the feed sediment to 430 mg/kg in sediment from extraction cycle 3 (reduction of about 80%). PCB concentrations below 50 mg/kg were achieved after five cycles in the verification runs and after seven cycles in the optimization runs. Data from extraction cycles seven through 10 indicated that once a PCB concentration of about 10 mg/kg was achieved, subsequent extractions did not result in significant reduction of PCBs. For example, between extraction cycles seven and ten in the verification runs, the PCB concentrations were reduced from 6.3 mg/kg to 4.8 mg/kg (E4) and from 8.2 mg/kg to 6.0 mg/kg (E5).

Oil and grease concentrations in the treated sediments ranged from 0.13 to 0.32% and concentrations of DIPA in the treated sediments ranged from 1.1 to 4.8 mg/kg. In addition, Ionics reported that results from the analysis of TCLP metals in the treated sediment were all were below regulatory levels.

Oil Polishing

As described above, the extract from the solvent extraction process (organic fraction) was sent to an oil polishing unit to concentrate the organic fraction or oil and reduce residual process solvent (DIPA), prior to sending to the SET® process for treatment. As shown in Table 4, during this concentrating step, PCBs concentrations increased by a factor of about five, from 9,850 mg/kg in the unpolished oil/solvent mixture entering the unit (S4) to 49,000 mg/kg in the polished oil exiting the unit (S10). Likewise, dioxins/furans were concentrated by a factor of about five, from 2,785 pg/g in unpolished oil to 15,000 pg/g in the polished oil. The results from the pilot tests of the SET® process for treating this oil are discussed below.

Table 4 - Oil Polishing Process Results [1]

Parameter	Unpolished Oil/DIPA (S4)	Polished Oil (S10)
PCB (mg/kg)	9,850	49,000
Dioxins/furans (PCDD/PCDF) - TEQ (pg/g)	2,785	15,000
Oil and Grease (%)	14.5	Not analyzed

SET® Performance

The concentrated oil from the B.E.S.T.® process (polished oil S10) was used as the feed material for the three SET® verification runs (Batches 5, 6, and 7). As shown in Table 5, data were collected on the PCB concentrations in the feed material (S10) and the PCB concentrations in the treated material from the SET® process (S11). Table 5 also presents the results from split samples collect by EPA Region 1 and analyzed in their laboratory.

The results show that PCB concentrations in the treated material from the SET® ranged from 1.3 to 5.1 mg/kg, below the target of 50 mg/kg. PCB concentrations were reduced by more than 99.99% in all three batches. Data from EPA Region 1 show PCB concentrations ranging from not-detected to 38 mg/kg.

Table 5 - PCB Results for SET® Process [1]

Batch #	PCB Concentrations (mg/kg)		
	Feed Material to SET® - Polished Oil (S10)	Treated Material from SET (S11)	Treated Material from SET® (S11) EPA Region 1
5	49,000	5.1	38
6	49,000	1.3	33
7	49,000	3.0	Not Detected

During the pilot test, difficulties were encountered in analyzing the treated material from the SET® process. Because excess sodium and sodium amides were present in the treated material, the material was reactive and caustic and had to be neutralized (using an acidic aqueous solution) prior to sampling. This produced an aqueous slurry with an organic (oil) fraction that would separate if left standing. As a result, when the non-homogenous matrix was sampled, it was difficult to obtain a representative sample. According to Foster Wheeler, it appears that the PCB data in Table 5 were generated by analyzing primarily the oil fraction of the treated material matrix. However, Foster Wheeler indicated that, because the majority of PCBs are likely to be contained in the oil fraction of the treated material rather than the aqueous fraction, it is reasonable to conclude that the SET® process is capable of reducing PCB concentrations from 49,000 mg/kg to levels ranging from not detected to 38 mg/kg.

Performance Data Quality [1]

Samples were analyzed using EPA methods or analytical methods similar to those used by an EPA Contract Laboratory Program (CLP) laboratory. In general, the data were used in the evaluation process as the data were found to be consistent and comparable to historical data and analyses typically performed under the EPA CLP program. PCDD and PCDF were analyzed for total isomers and 2,3,7,8-substituted congeners. TEQs were calculated for each 2,3,7,8-substituted congeners based on EPA toxicity equivalent factors. EPA Method 1311 was used to analyze TCLP metals.

A comprehensive quality control (QC) program was used during the testing, including field and laboratory duplicates, performance evaluation samples, and data validation. The results of the QC program indicated that, overall, analytical results were comparable and accurate for the purpose of assessing process performance as part of an engineering evaluation. While some QC results exceeded established criteria, resulting in some data being considered as “estimated”, the data did not pose a significant concern for the purposes of EPA’s engineering evaluation.

Cost Information [1]

The pilot-scale testing of solvent extraction/dechlorination for the Hot Spot sediments from the New Bedford Harbor Superfund Site were conducted by EPA under an Alternative Remedial Contracting Strategy (ARCS) contract. Foster Wheeler served as the prime contractor, providing overall management and technical oversight of the testing and preparing the evaluation report (Reference 1) and projected cost estimates for full-scale projects, with input from the vendors.

The projected cost for a full-scale B.E.S.T.® And SET® process were developed by Foster Wheeler using input from Ionic RCC and Commodore. The estimates were developed based on the following assumptions:

Assumption	B.E.S.T®	S.E.T.®
Amount treated	18,000 tons of Hot Spot sediment	423 tons of extract
Throughput	136 tons/day (based on a design capacity of 160 tons/day operated at an on-line factor of 85%)	3.2 tons/day using an 80% on-line factor

The projected costs are for treatment only and do not include other project costs associated with a cleanup such as design, procurement, site facilities, sediment removal from the CDF, handling of treated material, and air monitoring.

Table 6 - Projected Costs for Full-Scale B.E.S.T® and S.E.T.® Processes for Hot Spot Sediments [1]

Cost Element	B.E.S.T.® Process Only ($)	SET® Process Only ($)	Combined B.E.S.T.®/SET® Process ($)
Capital			
Equipment Costs	7,650,000	1,350,000	9,000,000
O&M			
Mobilization	815,000	142,000	957,000
Checkout/Startup	410,000	77,000	487,000
Reagents, additive, utilities	530,000	368,000	898,000
Labor and Support Management	944,000	343,000	1,287,000
Demobilization	200,000	142,000	342,000
Total O&M	2,899,000	1,072,000	3,971,000
Total Cost	10,549,000	2,422,000	12,971,000
Unit Cost	500/ton based on 18,000 tons of sediment	221/ton based on 423 tons of extract from 18,000 tons of sediment	721/ton based on 18,000 tons of sediment

Observations and Lessons Learned [1]

The Ionics RCC B.E.S.T.® and the Commodore SET® processes were effective in treating the PCB-contaminated Hot Spot sediment. The B.E.S.T.® process reduced concentrations of PCBs from as high as 2,515 mg/kg to below the target treatment goal of 50 mg/kg in as few as five extraction cycles, and PCB concentrations below 10 mg/kg were achieved after seven extraction cycles. In addition, TCLP metals in the treated sediment were below regulatory levels. The SET® process reduced concentrations of PCBs in the concentrated oil from the B.E.S.T.® process from 49,000 mg/kg to levels ranging from not detected to 38 mg/kg.

During the pilot study, problems were encountered with the feed mechanism for the SET® process, requiring modifications to the design and operation of the unit. These included modifying the feed mechanism design to handle semi-solid, waxy material rather than liquid and using excess sodium to address problems with untreated material contaminating treated material. Because excess sodium was used during this test, the chemical and physical composition of the SET® process treated product could not be accurately determined. According to Foster Wheeler, these issues were significant and could impact the viability of the process for use on a full-scale basis.

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