

Report on the Potential Source of PNAs

Benzo(a)pyrene and Benzo(a)anthracene

Attributed to Higman Barge Lines

This report addresses the possibility that benzo(a)pyrene ("b(a)p") and benzo(a)anthracene ("b(a)a") were deposited on the soils at the Palmer Barge Line Superfund Site as a result of spillage of either butterworth washings, barge steamings, or other activities carried out by Palmer that would have resulted in either of the two named compounds entering the soils to be excavated as part of the remediation at the Site.

In order to evaluate the possibility that Higman's barge residues might be responsible for the soil contamination by b(a)p and b(a)a, a theoretical exercise was made that examined the quantities of waste found in site soils and the quantities of Higman waste required to create those waste quantities. File documents were used as background for the evaluation: The Superfund Record of Decision, September 2005, Affidavits of John T. McMahan and Randy Laughlin (Original and Supplemental), and Page 3 of the Administrative Order identifying in Item 10 the list of hazardous substances found at the Site. Other sources of information are identified in the footnotes.

I have been an environmental consultant for over 30 years. My resume is attached for reference.

Some assumptions are required for this evaluation. They are listed as follows:

1. The quantity of soils that are contaminated is taken as 1,204 cubic yards
2. The level of b(a)p in that waste is 280 mg/kg<sup>1</sup>
3. The level of b(a)a in that waste is 240 mg/kg<sup>2</sup>
4. The solubility of b(a)p in water is  $3.8 \times 10^{-3}$  mg/L<sup>3</sup>
5. The solubility of b(a)a in water is  $5.7 \times 10^{-3}$  mg/L<sup>4</sup>
6. The content of b(a)p in Vacuum Gas Oil ("VGO") is 0.1 wt. Percent<sup>5</sup>
7. The content of b(a)a in VGO is 0.1 wt. Percent (assumed to be the same as b(a)p)
8. One cubic yard of soil at the Site weighs 2000 lbs (1 Ton) (assumption)
9. Crude oil contains 10% VGO (assumption)

<sup>1</sup> Record of Decision, Table 8

<sup>2</sup> Record of Decision, Table 8

<sup>3</sup> EPA Hazardous substances List

<sup>4</sup> EPA Hazardous substances List

<sup>5</sup> Marathon Oil Co. MSDS 0229MAR019

Using these values I was able to estimate the quantity of water needed to infiltrate the site soils to deposit the quantity of b(a)p and b(a)a reported in the Record of Decision (Table 8). In summary here are the pertinent calculated values:

- a. There are 577.92 pounds of b(a)p in the soils to be removed from the Site
- b. There are 674.24 pounds of b(a)a in the soils to be removed from the Site
- c. The volumes of water required to deposit the calculated b(a)p and b(a) are 18.264 and 14.205 billion gallons, respectively.
- d. The quantity of VGO required to have been spilled at the Site to account for the quantity of b(a)p and b(a)a in the soils to be removed is 64,162 and 74,855 gallons, respectively.
- e. The quantity of crude oil required to have been spilled at the Site to account for the quantity of b(a)p and b(a) in the soils to be removed is 641,620 and 748,557 gallons, respectively.

The quantities of water and oils, VGO and crude, resulting from the calculations are unreasonably large. To gain perspective, the volume of the soils to be removed is only 243,160 gallons. So the quantity of crude is several times the volume of soil to be removed and the volume of VGO is approximately 25% of the soil volume. The volumes of water are absurdly high in comparison to the volume of soil to be removed.

To further evaluate the possibility for contamination to be derived from wastes from Higman barges, alternative assumptions can be made. For example if we take the TR as  $1 \times 10^{-6}$  for b(a)p which is 0.23 mg/kg (ROD Table 8) as the contaminant level, I can calculate a smaller quantity of b(a)p in the site soils. This assumption reduces the quantity of water required by approximately 1000 times. However, the volume of water is still inconceivably large at 17.5 million gallons.

There are similar reductions in the quantities of VGO and crude oil. Those reductions could, however, be considered reasonable to occur. Using the b(a)p value for the TR at  $1 \times 10^{-6}$  (0.23 mg/kg) as the contaminant level, requires about 1 drum of VGO and 15 drums of crude oil.

There are two facts that would limit the loss of these materials to the environment: their inherent value as fuel for Palmer in the production of hot water and steam for cleaning barges<sup>6</sup>, and the fact that it would be difficult, if not impossible, to spill these quantities uniformly over an area as large as that to be excavated (Ref. Alternative 4 in the ROD). If we assume that 90% of the VGO and crude oil was recycled or sold by Palmer the 15 drums of crude would be 1.5 drums and the 1 drum of VGO becomes 0.1 drum. Further, at the lower concentration of b(a)p assumed in the further evaluation, the Higman contribution by spills of VGO or crude would approach 10% of the concentration to produce a  $1 \times 10^{-6}$  risk level (resulting in no risk) and nearing the minimum detection limit of b(a)p in soils..

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<sup>6</sup> Randy Laughlin in his Supplemental Affidavit, paragraph 5. I agree with Mr. Laughlin's assessment that recovered crude and VGO are valuable commodities for either sale or internal use.

In conclusion, calculations indicate that Higman Barge Line could not have been responsible for site soil contamination at the maximum or toxic trigger levels indicated for b(a)p and b(a)a by means of waste water discharge. Spillage to generate contamination at the maximum soil concentration value of VGO or crude oil produces more oil than soil to be removed, an impossible situation. Similarly, if the risk level is lowered to the trigger value of  $1 \times 10^{-6}$ , water spillage is still too large to be reasonable for a small site and if the valuable hydrocarbons, crude oil and VGO, were recycled by Palmer, and still 10% was lost the levels in site soils are below the  $1 \times 10^{-6}$  risk level and would not require remediation.

**PAUL FAHRENTHOLD**

hazardous waste treatment  
remedial program design  
process engineering

**EDUCATION**

Florida State University: Postdoctoral Fellow, 1966  
University of Houston: Ph.D., Chemistry, 1966  
Rice University: M.S., Chemical Engineering, 1962  
University of Texas: B.S., Chemical Engineering, 1960

**REGISTRATION**

Registered Professional Engineer: Mississippi and California

**PROFESSIONAL HISTORY**

Fahrenheit & Associates, Inc., 1988 to Present  
ENTRIX, Inc, Vice President, Waste Management/Water Resources Group, 1986 to 1988  
Woodward-Clyde Consultants, Senior Consultant, 1982-1986  
U.S. Environmental Protection Agency, Chief of Organic Chemicals Branch, 1972-1982  
Calumet Petrochemicals, Vice President, 1967-1972  
Calumet Industries, Technical Assistant to the President, 1967-1972  
Texas Eastman Company, Research Chemist, 1966-1967

**REPRESENTATIVE EXPERIENCE**

Fahrenheit & Associates has completed a number of environmental engineering and process chemistry development projects. Those projects have focused on the detection and quantification of contaminants in various media, design and construction supervision of facilities for restoration of the environment, recovery of raw materials, treatment of waste water discharges and atmospheric emissions, and the evaluation of data for clients desiring contributions from named and unnamed PRPs.

Abstracts of representative projects are provided below.

#### Pacific Sound Resources-Seattle, WA

Fahrenthold & Associates designed a combined biological and physical/chemical treatment system for removal of hydrocarbons from groundwater at the facility. The design included coordination of the pumping system and transport of the water to the treatment system, supervising and coordinating the design of the biological treatment facility, and preparing the monitoring program for the facility to determine compliance with the environmental regulations.

In addition to the engineering work for treatment projects identified above, Fahrenthold & Associates has coordinated the groundwater investigations at two sites in the Seattle area. In doing so the company's staff has gathered experience in groundwater management, infiltration, tidal effects and other aspects of water management.

#### Joleen Way PRPs-Morgan Hill, CA

For this group Fahrenthold & Associates designed and supervised the construction of a multi-location treatment complex for contaminated groundwater.

The design included preparation of the process and instrument diagrams for the facility, selection of equipment and supervision of its installation. The treatment process used was adsorption of organics from solution followed by their recovery by steaming the adsorbent beds and recovering the organic contaminants. Several of the treatment facilities were located some distance from treatment. Pipelines for vapor and water were designed and installed to transport these fluids to environmentally suitable locations.

After completion of construction, Fahrenthold & Associates operated the facility for a number of years, including the maintenance and monitoring programs.

#### Process Chemistry Experience

For a major refiner in northern California a survey was made of the 17 pools of hydrocarbon under the facility to determine their age. Calculations were prepared that indicated the relative age of the deposits, as possible. Most of the calculations focused on the loss of hydrocarbon components through the vadose zone, the primary mechanism of ageing. The data produced in the study were used to prepare a chain of liability for the facility that had operated since early in the 20<sup>th</sup> century.

For a major utility in New Mexico a survey was made of a facility where field condensate had migrated from the field tanks to the general area outside of the battery limits of the production area. The loss of hydrocarbon components from the deposit of hydrocarbons in the ground into the vadose zone was calculated and found to coincide with a spill event six years before sampling occurred. The data were used to determine the entities' liable for the loss of hydrocarbon from the facility.

For a Connecticut corporation Fahrenthold & Associates developed an in-situ process for the destruction of carbon disulfide. The process, after development, was approved by EPA for field implementation. Field implementation led to treatment of approximately 10,000 yards of contaminated soil. The process was subsequently patented by the company.

In the defense of refiners in Texas, Fahrenthold & Associates surveyed three facilities to determine the origin of benzene emissions. The sources were then modeled backward in time (from 1975 to the early 1980s) using process correlations developed by the API and the USEPA. The calculated process emissions were used as input for a dispersion model of each of the facilities.

In a project in Pennsylvania Fahrenthold & Associates evaluated the process chemistry for evaluation of contaminants at a disposal site that had potentially migrated to nearby groundwater supplies. The evaluation required the reconstruction of process chemistry used to manufacture resorcinol and petroleum sulfonates and the development of an analysis method for these non-priority compounds.

In a cost recovery case for a refiner in Houston, Fahrenthold & Associates evaluated the chemistry and material balance production of wastes from a paint manufacturing facility and a major paper mill to determine if their chemical signatures matched the wastes deposited at a disposal site under remediation. The material balance was constructed to determine if the wastes generated were in general agreement with the volumes recorded as disposed at the site.

For a major utility company Fahrenthold & Associates developed an analytical methodology and assisted in developing a procedure for the determination of the quantity of bunker fuel in a soil matrix. The soil matrix was contaminated with a highly aromatic product (pitch). A mathematical algorithm was used to estimate the quantities of bunker fuel, pitch and diesel fuel in the soil matrix. Standard, but not environmental, analysis techniques were used to establish the data base for the required calculations.

#### **Cost Recovery Projects:**

Cost Recovery and Allocation Model Creation or Evaluation: Through the use of air modeling and material balance data for a series of facilities the basis for cost modeling and allocation of remediation costs was created. The methodology developed for the facilities, all of which were similar, was used at four installations as the basis for contribution actions.

This air deposition modeling technique was used successfully to determine the individual liability for multiple operators of several facilities over an extended time frame.

The entire methodology was recently presented at a national meeting of the Society of Risk Assessment as a means to evaluate the risk potential of soil contamination from atmospheric deposition of particulate matter.

Other studies focused on cost allocation have been successfully completed which were designed to use either air deposition modeling or studies of chemical differences among or between operating periods and facilities to determine contribution to chemical contamination.

#### Chemical Material Balance Projects and Background Information

As a young chemical engineer I was a process engineer for Union Carbide Corporation in the design of plants to produce ethyleneamines and oxo alcohols. Subsequently, I designed a full scale plant for Calumet Industries for the manufacture of sulfonic acids and their salts to be used as lubricating oil additives.

I have directed and worked in pilot plants and chemical research labs in the development of various production and waste treatment processes.

When I was in the EPA I became the Branch chief of the Organic Chemicals Branch of the Office of Water, Industrial Technology Division (new name). In that position my staff and I developed a procedure to prioritize industrial chemical processes according to their capacity to generate toxic pollutants. The process is relatively simple requiring knowledge of the raw materials and the chemistry of the processes used at the facility. This sounds simple but it requires practical knowledge of industrial chemistry and industrial operations.

Using this formula we were able to analyze the top 100 chemical and polymer production processes for their production of toxic chemicals into all media (solid wastes and effluents) on a unit of raw materials basis. We also did the pesticide and pharmaceutical industries. As a result of the analyses we were able to design treatment technology suitable for regulation, where necessary.

I have done a lot of chemistry projects in the past few years. For Jones, Day in Houston (Michael Gibson is the contact) I did waste material balances for PPG industries (paint manufacturing chemistry) and for Champion Paper in Pasadena, Texas (all types of paper plant processes such as bleaching, wood yard, lime kiln, digestors, etc.).

I also did a material balance study for the DelAmo site in California. I looked at the process chemistry for butadiene and synthetic rubber manufacture at the complex. I believe that the issue was similar to the one presented to me by Jones, Day in that there was an allocation to be made at the site.

In cooperation with Jacobs Engineering a survey was made of the lube additive and transformer oil processes at their Gretna facility to evaluate their process chemistry and engineering designs. The evaluation had as its goal minimizing waste generation by the facility through process modification and better waste management. The project closed with a report of the process options available and their cost.