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Dioxin in Missouri: 1971–1983

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From April, 1970 through January, 1972 NEPACCO, Northeastern Pharmaceutical and Chemical Company, in Verona, Missouri leased a chemical plant to produce hexachlorophene from 2,4,5-trichlorophenol (Figure 1). During this production, 2,3,7,8-tetrachloro-dibenzo-p-dioxin was formed and concentrated in still bottoms and in filter cakes. Approximately 12,000 gallons of the still bottoms were incinerated in, presumably, an environmentally safe way. Forty three hundred gallons remains stored on-site, and 18,000 gallons was removed by a waste oil hauler and subsequently sprayed on roads, truck lots and riding arenas primarily located in eastern Missouri. Also, approximately 25,000 gallons of waste water was sent to the Waste Management School in Neosho, Missouri and filter cake was sent to local farms for burial. In the latter case, farmers were paid to dispose of filter cake in barrels and drums on their land.

While the filter cake and the wash water does pose a major problem in southwest Missouri, the site receiving the most attention in that area is the Spring River. In 1982 a health advisory was issued by the FDA alerting the public as to possible health effects which might result from eating fish from the Spring River. The data upon which this advisory was based indicated that in seven samples of whole fish, the concentration of TCDD was 26 parts per trillion (ppt) and in eight samples of filets, 18 ppt of TCDD was found.

These two major points concerning southwest Missouri aside, the story of dioxin contamination in Missouri is really the story of the widespread contamination of dioxin in soil in the eastern part of the state: dirt roads, unpaved truck lots, horse arenas. From February 16, 1971 to October 25, 1971, six truck loads of still bottoms of approximately 3,000 gallons each were hauled to eastern Missouri. Almost all of this material was either sprayed directly or in a mixture with waste oil as a dust suppressant. In all, the EPA estimates that approximately 100 times the total amount of TCDD was sprayed on Missouri that was released during the Seveso incident (American Institute of Chemical Engineers 1983). The total amount of TCDD released in Missouri was about 20-25% of the amount that was

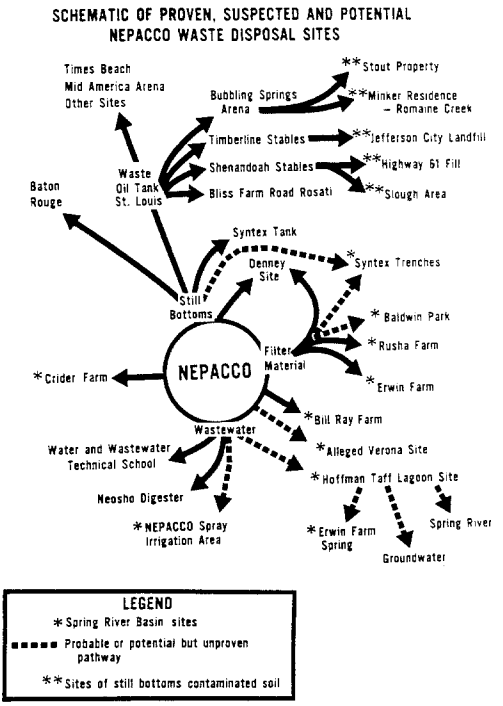

Figure 1. Schematic showing the fate of dioxin from the NEPACCO plant.

sprayed on Vietnam during the period that Agent Orange was being used as a defoliant.

There are three eastern Missouri sites which are important in understanding the history of dioxin contamination in Missouri. First is the Shenandoah stable site (see Dr. Kimbrough's article) where on May 25, 1971 undiluted still bottoms containing TCDD at concentrations up to 350 parts per million (ppm) were sprayed on Shennandoah stables. The total dose of TCDD has been estimated to be in excess of six pounds. The following day, horses became sick and eventually nearly 75 died or had to be destroyed. Within a week sparrows were literally falling out of the rafters and many other domestic and other wild animals were sick or dying. In August of 1971, a six year old girl was admitted to St. Louis Children's Hospital. Two days later the Centers for Disease Control (CDC) was consulted. In August of 1971 the samples were taken. Before any conclusions were drawn from the tests, the stables were excavated and, in November of 1971, animals were returned. According to some reports they continued to get sick and die. Fortunately, one of the co-owners of the stables

had become suspicous and trailed the waste oil hauler. Her documentation of his visits provided crucial evidence revealing other dioxin sites. Results of CDC's tests on the soil samples were not available for three years.

Shenandoah stables represents the first place where there was a documented illness in humans. It was also where TCDD was conclusively identified. Today, it still has the highest levels of contamination, about 1200 parts per billion (ppb) in the slough area (Missouri Dioxin Task Force, 1983).

Another site which is very important in understanding our dioxin history is the Bubbling Springs site. This is another arena sprayed in 1971 at which several horses died. This site was excavated and the excavated soil was hauled away by Mr. Stout, who used it for fill at the Minker residence and at the Stout residence. Hence, we have the Minker/Stout site, which was one of the first sites announced for the EPA "buy out" under "Superfund." It has been sampled at between 85 and 740 ppb and has been put on the national priority list. A recent study (McConnell et al. 1984) has shown that the soil is toxic to certain animal species.

One of the biggest problems at the Minker site is the severe erosion which has caused considerable contamination in Romaine creek. TCDD levels in the creek have been reported up to 270 ppb and dioxin has been detected two feet underneath the surface of the creek. Furthermore, bottom feeding whole fish taken from the Meramec River near the mouth of Romaine Creek have shown levels of TCDD above 78 ppt.

Along with the Minker site goes the Stout site. Soil was hauled from Bubbling Springs to the Stout site and used for deep fill. Testing down to 20 feet indicates TCDD contamination. When combined with the Minker site, the Stout site represents a total of between 5,000 and 8,000 cubic yards of soil which must be removed in order to decontaminate the area.

The other major site which receives the most press and seems to be running a good race to unseat Love Canal as being known as the environmental disaster of the 20th century is Times Beach, where roads were sprayed in 1972 and 1973. Times Beach was first sampled in November and December of 1982 and the advisory to evacuate Times Beach was issued December 23, 1982. On February 22, 1982, the EPA announced that they would buy the entire city of Times Beach, making it unique in the history of environmental disasters. Once purchase is completed, the city will no longer exist.

Times Beach is in the flood plain of the Meramec River. This river had two 100 year floods in 1982 and 1983, each of which flooded Times Beach. Fortunately, this flood plain is not a scouring area. Sampling done before and after the two major floods indicated that there were no appreciable changes in the TCDD contamination. Times Beach houses over 60% of the known TCDD contaminated soil in Missouri.

In summary, there are over 25 miles of roads, most at Times Beach. The recent discovery of contaminated fish in the Meramec River has focused attention on Romaine Creek. Potentially, several miles of the Spring River will require remedial action. There are depths of contamination of twenty feet. Besides the Minker residence where severe erosion caused the contamination at Romaine Creek, erosion at one of the other horse arenas has possibly caused the contamination of another stream which feeds the Meramec River. At the Jones truck site in the City of St. Louis, samples of rafter dust have indicated the presence of TCDD. This opens the possibility of an inhalation route as a source of exposure. This has further been stressed by the discovery of a soft tissue sarcoma in a former truckyard worker.

Usual methods call for for dealing with hazardous waste in a waste stream; however, most of the dioxin in Missouri is not a waste stream, it is contaminated soil. It is distributed over 38 known sites and over 100 more sites are currently under investigation. It adheres to soil, implying that any method that one would use to destroy it would first require disassociating it from the soil. Incineration would probably require an initial volatilization step and then destruction in its volatilized form. In solvent extraction, there is a unit operation explicitly involving the removal of the TCDD from the soil with a subsequent destruction operation. Any of these methods must be capable of handling large quantities, greater than a half million cubic yards and a large range of contamination levels.

Besides how it got there and what is there, the other major question I wish to address is "Why have we not done anything about it until now, especially when TCDD was positively identified in 1974?" Probably the main reason for this is the misapplication of the concept of "half life." This issue was specifically addressed by the Missouri Governor's Dioxin Task Force, which concluded that the concept as applied to dioxin contaminated soil was invalid. A typical sample of surface soil is shown in Figure 2. Considering this as a control volume, we ask the question "What are the fundamental mechanisms by which TCDD enters and leaves the control volume?" A number of mechanisms are noted, including: surface movement of soil particles, erosion, vaporization (which is believed to be a mechanism at the very early stages of spraying), transport by living organisms, transport by solubilization, motion of small particles containing TCDD, molecular diffusion and, finally, the rate of decay. Here, the rate of change of TCDD in the region of interest is governed by many factors including the rate of decay, which is the basis for the concept of half life. In soil analysis, one measures the combined effects of all of these factors, not only the half life.

The confusion of the scientific basis of the use of the term "half life" was partly the basis on inaction. On March 31, 1975, a CDC report (CDC, 1975) indicated that the "half life," i.e. the rate of disappearance, was one year. A Missouri Department of Natural

Resources report in July of the same year also used this figure. Another report (Missouri Department of Natural Resources, 1975) indicated that the "half life" of TCDD was between 0.24 and one year. Hence, the conventional wisdom through the mid-1970s was that this material would decay in the short term.

The realization that TCDD does not "decay" brings us to the modern history of TCDD contamination in the state of Missouri, which begins during the fall of 1981 through the spring of 1982. At that time EPA consolidated its internal records. New sites were discovered in

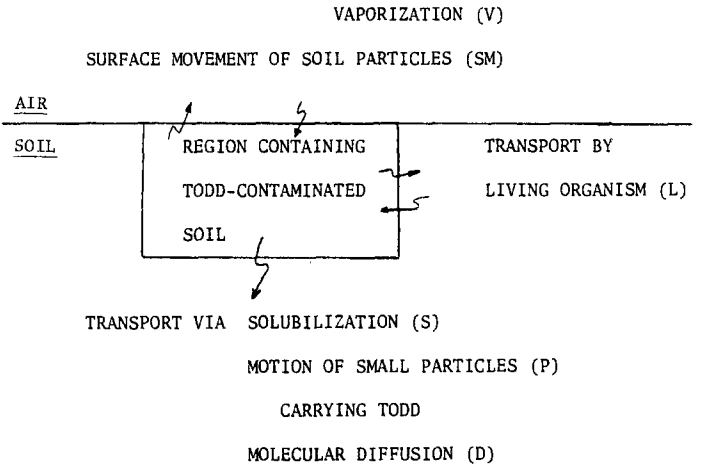

Figure 2. Control volume of soil along with many probably transport mechanisms.

southwest Missouri. In March, 1982 the health advisory relating to Spring River fish was issued by the Food and Drug Administration. There was a new round of sampling in June, 1982, and exchanges of information among the Division of Health, Department of Natural Resources, EPA and CDC. All of this activity came to a head on October 27 when the Environmental Defense Fund released EPA internal documents listing possible sites. At that time, there were 14 confirmed sites and 41 more under investigation. Today we have the 38 confirmed sites and approximately 200 under investigation.

As a result of these events there have been several responses. The media response has ranged from an excellent supplement that appeared in the St. Louis Post Dispatch (1983) to a confused and rhetorical editorial in the Wall Street Journal (1983).

More important has been the response of the Missouri State Legislature in passing two major pieces of legislation: a "cancer registry bill" requiring that hospital administrators file with the State information concerning reported cancers; and the "State Superfund" which has instituted a head tax on all employees of hazardous waste generators and has put a $25 per ton on all hazardous wastes that are land filled.

Regarding the citizen response, there are two major trends. One is the formation of residents/victims groups and the other is the interaction of these groups with environmentalists. The residents/victims groups are demanding contracts with government agencies concerning health studies and clean-up criteria. In eastern Missouri, there is the Contaminated Sites Residents Committee representing about ten sites. In southwest Missouri there is the Spring River Dioxin Committee. For the truck sites in St. Louis city, the Teamsters Local 600 has instituted a dioxin task force. The Missouri Coalition for the Environment, a state-wide environmental group, has been providing legal and office support and has been coordinating among all of these groups. In the future it appears that there may be a coalescing of groups and there will be new issues raised.

On the administrative front, at the state level, the Governor's Dioxin Task Force recommended the development of an overall strategy for dealing with all of the sites at one time. It was recommended that all the soil be consolidated at a single location and the TCDD destroyed when the technology catches up. Times Beach has been suggested as the site of the central storage facility.

As a member of the Task Force, I believe there were a couple of faults with its final report. First, specific statements concerning economic compensation cannot be found. Second, the long-term physiological effects on affected individuals were not addressed.

Finally, as this conference shows, there is the educational aspect or the educational response to the dioxin crisis. Most attending this conference are from St. Louis. Some of the out-of-state speakers who have come for this conference have also spent much time here in the last year helping us overcome this problem. It is good for us, as Missourians who have been affected, to educate those who are here today concerning the uniqueness and magnitude of the Missouri dioxin problem and to try to progress beyond our current knowledge.

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