Expert Report

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CASE

Permit Appeal: Army for a Clean Environment, Inc. v. Commonwealth of Pennsylvania Department of Environmental Protection and Lehigh Coal and Navigation Co. (LCN)

QUALIFICATIONS

I am currently an Adjunct Assistant Professor in the Department of Preventive Medicine and Community at the University of Texas Medical Branch in Galveston, Texas. My major area of expertise is in toxicology, specifically genetic toxicology. Genetic toxicology is that field of toxicology that is concerned with the effect of chemicals on genetic material. My early research focused on this area of toxicology. Most recently, my research in academia has focused on the use of a comprehensive symptom survey to examine the effects of chemical exposure on communities exposed to chemicals in the environment. For the last 15 years, I have primarily been a consulting or testifying expert witness in toxicology in litigation matters involving chemical exposures with a wide variety of chemicals. A copy of my most recent curriculum vitae is included with this preliminary report as Appendix A. A list of the legal cases in which I have provided oral testimony in the past 10 years is included as Appendix B.

ASSIGNMENT

My assignment in this case is to analyze the toxicological aspects of the appeal of the permits in the above case including an assessment of the risks involved with the activities allowed by the permits.

BASIS FOR MY OPINIONS

For this case, I have reviewed a number of documents that were either provided to or gathered by me in the course of my investigation. For the purposes of this report, I have referred to specific documents as references which are listed in the final section of this report. A further listing of the materials that I have reviewed is included as Appendix C.

I have also based my opinions upon my years of research and my other academic and litigation related expertise in toxicology.

OPINIONS IN THIS CASE

Following are my major opinions in this case. All are given with a reasonable degree of scientific certainty.

1. Toxic substances, including carcinogens, are present in the proposed fill materials of coal ash, lime kiln dust (LKD), cement kiln dust (CKD) and dredge materials.

There are many toxic substances present in the proposed fill materials. Of major importance are the many carcinogens present. A review of the analyses provided to date shows that the dredge materials contain at least 10 human carcinogens. It has also been

shown that CKD contains carcinogenic metals. Analyses of the ash that have been provided to date also show the presence of carcinogenic metals along with the presence of Arochlor 1254, a polychlorinated biphenyl.

2. Not all potential toxic substances have required monitoring.

There are several important items that the monitoring for the coal ash does not include in the General Permit WMGR085 (PaDEP, 2004) as delineated in the Certification Guidelines for Beneficial Use of Coal Ash (PaDEP, 1998). First, beryllium has been shown to be present in power plant ash along with presence in the wastewater. The conclusion was that long-term pollution resulted from slag and ash dumps (HSDB, 2005). As beryllium is listed as a known human carcinogen (NTP, 2005), it is important that this metal be monitored as part of establishing the safety of the ash. Also, radionuclides have been reported to be present in fly ash (Reviewed in Morris et al, 1989) including ash from power plants burning coal (Weng and Chu, 1992; Roeck et al, 1987; Globel and Andres, 1985) and lignite (Karangelos DJ et al, 2004). Finally, polyaromatic hydrocarbons (PAHs) have been shown to be present in fly ash (Morris et al, 1989) although recent monitoring of provided ash samples does not show detectable levels of these compounds. Monitoring of PAHs is not required according to the permit. However, monitoring of these constituents should be required to fully establish the safety of the ash used in reclamation.

General Permit WMGR085 lays out the criteria for not accepting cement kiln dust (CKD) or lime kiln dust (LKD) for use. Draft documents from the USEPA have shown that CKD contains heavy metals and chlorinated dibenzodioxins and dibenzofurans

(USEPA, 1988; USEPA, 2000). WMGR085 does not require that these chlorinated compounds be monitored in the CKD.

General Permit WMGR085 lays out the criteria for not accepting dredge materials for use in coal mine reclamation. Although there are many chemicals proposed for screening, one major category has not been adequately considered. Although certain chemicals classified as endocrine disruptors are included in the required analyses, certain others are not included. Of specific note are the alkylphenols, which are found in river and harbor sediments. (Hashimoto S et al, 2005;Cespedes R et al, 2004; Petrovic M et al, 2004; Isobe T et al, 2001) I have reviewed analyses of dredge materials, which include samples from the New York/New Jersey Harbor, Delaware River and Mt Pisgah Mine Reclamation Demonstration Project. Certain key endocrine disruptors are not required and have not been included in the analyses.

In addition to the endocrine disruptors mentioned above, there is also the situation for natural and synthetic estrogens to be present in dredge material. River sediments can act as sinks for estrogens and proestrogens. It has been estimated that between 13 and 93% of estrogens entering a river end up in the sediment (Petrovic et al, 2004).

Of importance in considering the health impact of the proposed fill materials is the issue of estrogen disruptors. Effects from these compounds are found at very low levels (Ulrich EM et al, 2000; Bulayeva NN and Watson CS, 2004, Hayes TB, 2006). Also, these compounds are well known to accumulate in human fat and mobilize during fasting (Penza M et al, 2004). Estrogenic activity can be shown in fat samples that are limited to exogenous rather than endogenous estrogens (Fernandez et al, 2004). Combining these endocrine disruptors can show effects even when each individual

chemical is below its no effect level (Rajapakse N et al 2002; Silva E et al, 2002). Animals fed fish known to have been exposed to endocrine disruptors have effects on male reproductive functions at relatively low concentrations (Aravindakshan J et al, 2004).

3. **Some proposed levels are high compared to other guidelines available.**

For some chemicals, the acceptable levels in the permit are in excess of other guidelines available. For example, the permit allows arsenic at 41 mg/kg. Even though this is substantially lower than the level of 150 mg/kg that LCN originally proposed, it is well above the level of 1.9 mg/kg for industrial soil shown in the USEPA Region III Risk-Base Concentration Table (USEPA Region 3, 2004) or the level of 0.24 mg/kg for industrial soil shown in the California Human Health Screening Levels (CalEPA, 2005). There is a background level of arsenic in soil with these levels reported at <0.1-97 mg/kg, with an arithmetic mean of 7.2 (ATSDR, 2000).

4. **The proposed fill materials contain toxic substances than can interact and have synergistic, additive or antagonistic effects. Because of the complexity of the mixture, many reactions may not be predicted.**

    a. Metals

As noted, all of the proposed fill materials contain metals. One of the aspects of metal toxicity is the possibility of additive or synergistic effects. For example, studies with animals show that there is a potentiation of renal toxicity when arsenic and cadmium are combined (Liu J et al, 2000). Similar effects are also seen in exposed human populations (Buchet J-P et al, 2003; Hong F et al, 2004). Studies in culture indicate that

arsenic can potentiate the genotoxicity of benzo(a)pyrene, a well studied PAH (Maier A et al, 2002). Interactions may be quite complex, ranging from antagonistic to synergistic in the same system as dose is changed (Maier A et al, 2002).

b. Endocrine disruptors

Combining endocrine disruptors can show effects even when each individual chemical is below its no effect level (Rajapakse N et al, 2002; Silva E et al, 2002). Because dredge material represents a complex mixture that contains endocrine disruptors, this type of interaction may take place.

c. Unknown interactions

In essence, the materials proposed in reclaiming the Springdale Pit contain a large number of chemicals that are potentially harmful. Because of the complexity of the materials, it is difficult to predict what interactions will occur. Some interactions have been postulated. For example, the addition of hydrogen peroxide to the mixture may result in the conversion of trivalent chromium to the more toxic hexavalent chromium.

5. Leaching tests performed in the laboratory do not adequately simulate conditions found in the environment.

Laboratory studies have shown that leaching of metals from coal combustion products is dependent upon pH. However, single batch tests do not address this phenomenon. Also, results from leachates collected in the field differ from laboratory data. "These tests do not use leaching solutions that are representative of the large range of geochemical conditions likely to be encountered in mines, and they may greatly underestimate the actual leaching that will occur." (National Research Council, 2006)

These concerns do not apply only to characterization of coal combustion residues. In a document prepared for the USEPA on cement kiln dust, it was stated "Leachate testing of CKD from the property was performed and a few parameters were found to be at concentrations greater than groundwater samples. This type of sampling and analysis should not be used to replace groundwater sampling" (Tetra Chem EM, Inc, ----). Other researchers have concluded that the ability of the cement and CKD samples to buffer the acidity of the leaching solutions is a factor in TCLP testing. "This factor calls into question whether these high pH solutions could represent any 'real-world' condition and implies that the TCLP in not suitable for assessing the leaching behavior of alkaline systems such as cement and CKD" (Eckert and Guo, 1998).

6. Distribution of toxic chemicals is not consistent in sediments and this variability must be taken into account in the sampling protocols of the dredge materials

The distribution of toxic substance in sediments is not consistent. For example, several studies have shown that endocrine disrupting chemicals or the estrogenic activities of sediment vary according to location (Petrovic M et al, 2004; Isobe T et al, 2001; Hashimoto S et al, 2005). As an example, nonylphenol has been found to vary with depth in Tokyo Bay with maximum concentrations correlating to sediments from the mid-1970's (Hashimoto S et al, 2005). Estrogenic activity has also been shown to vary with depth along with tremendous variations seen in the location of surface sediments (Hashimoto S et al, 2005). Uneven distribution of metals also occurs in harbor sediments (Jones et al, 2001; Wakeman and Themelis, 2001, Johannssen SC et al, 2005).

Therefore, special care must be taken to insure that this variability be taken into account in the sampling protocols.

7. **There is evidence that the environment in the area will be damaged if the toxic materials in the proposed fill materials are not properly contained. Human health will also be affected.**

Examples of adverse environmental effects from placement of coal combustion residues in landfill or surface impoundments has been recently summarized by the Committee on Mine Placement of Coal Combustion Wastes of the National Research Council. (National Research Council, 2006). As pointed out, these examples illustrate the types of damage that may occur if the disposal of the coal combustion residue is not properly managed. This included a discussion of the role of bioaccumulation. The committee also felt as if human health could be adversely affected by the leachates from coal combustion residues used at mine sites. There are published examples of environmental effects from contaminants in dredge materials as well. Raccoons captured in an area containing dredge showed a higher accumulation of metals that those captured in a control site although the sample size was small (Winger et al, 2000). Maine mussels exposed to sediments from a harbor in the southern part of the United Kingdom showed genotoxic effects (Jha et al, 2000). While this study specifically addressed the marine environment, it does point out that marine sediments can contain genotoxic materials.

The Pennsylvania Fish and Boat Commission has designated the Little Schuylkill River in the area around Tamaqua as “approved trout waters” for 2006. According to

PADEP Chapter 93 of the Water Quality Standards, this area is designated as a cold water fisheries area (LCN, 2004). Numerous studies have shown that many fish are susceptible to the effects of endocrine disruption by chemicals that are found in the environment (Mill and Chichester, 2005; Arukwe, 2001).

8. **Because of the uncertainty involved in predicting the harmful effects of the proposed fill materials on humans and the environment, including synergistic, additive or antagonistic effects, the proposed fill materials should not be placed in an unlined pit where discharge to the environment can occur.**

The recent analysis of the use of coal combustion residues in mines points out that "Uncertainty is unavoidable in predictions of contaminant behavior and transport in the environment." This report goes on to point out that this uncertainty could be reduced by the use of redundant engineered liners and/or caps (National Research Council, 2006). Because it is well established that toxic substances are present in the proposed fill material and numerous uncertainties exist, it is imperative that measures be taken to insure that these compounds are adequately contained. The proposed materials should not be placed in an unlined pit.

The USEPA has also proposed standards to manage CKD in landfills, which includes the use of composite liners in landfills (USEPA, 1999). There is some evidence that groundwater has been impacted by the presence of CKD (Tetra Tech EM, ----). The regulation of CKD is currently under consideration by the USEPA (USEPA, 2002).

9. Inadequate dust control will result in health problems in individuals near the site.

Dust control is another aspect of the reclamation that deserves attention. It should be noted that residents surrounding cement kilns have been shown to suffer more respiratory symptoms than in residents in areas without cement kilns (Legator et al, 1998). Because of this, care should be taken to avoid exposures of individuals to the CKD. Also, a local physician has noted an increase in respiratory symptoms in the Tamaqua area. As fly ash is known to cause respiratory effects in animals (Morris et al, 1989) and pulmonary effects in a case report of extensive exposure in an individual (Shrivastava DK et al, 1994), exposure to the fly ash should be carefully monitored and limited. This has been a problem in the past as PaDEP personnel have noted blowing dust from coal ash on the property (LCN, 2003). It should also be noted that both CKD and LKD contain calcium oxide (Turner-Fairbank Highway Research Center, 2006) which is know to be a respiratory irritant (HSDB, 2006)

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