POISONS IN THE PIPELINE

TESTS FIND TOXIC STEW IN OIL SPILL

ENVIRONMENTAL WORKING GROUP

JUNE 2013

PHOTO: EPA

www.ewg.org

1436 U Street. NW, Suite 100
Washington, DC 20009

Contents

Acknowledgements

This report was made possible by the support of clean energy advocate and philanthropist Tom Steyer.

ENVIRONMENTAL WORKING GROUP

www.ewg.org

Researchers
Renee Sharp
Johanna Congleton
Nneka Leiba
Editor
Nils Bruzelius

Designers
Aman Anderson
Ty Yalniz

HEADQUARTERS
1436 U Street. NW, Suite 100
Washington, DC 20009
(202) 667-6982

CALIFORNIA OFFICE
2201 Broadway, Suite 308
Oakland, CA 94612

MIDWEST OFFICE
103 E. 6th Street, Suite 201
Ames, IA 50010

SACRAMENTO OFFICE
1107 9th Street, Suite 625
Sacramento, CA 95814

About EWG
The mission of the Environmental Working Group (EWG) is to use the power of public information to protect public health and the environment. EWG is a 501(c)(3) non-profit organization, founded in 1993 by Ken Cook and Richard Wiles.

POISONS IN THE PIPELINE

Tests Find Toxic Stew in Oil Spill

BY RENÉE SHARP, M.A., DIRECTOR OF RESEARCH
JOHANNA CONGLETON, PH.D., SENIOR SCIENTIST
AND NNEKA LEIBA, M.P.H., DEPUTY DIRECTOR OF RESEARCH
ENVIRONMENTAL WORKING GROUP

AS THE NATION DEBATES WHETHER THE PROPOSED KEYSTONE XL PIPELINE SHOULD BE SHELVED OR MOVE FORWARD, A KEY QUESTION REMAINS: WHAT KINDS OF TOXIC CHEMICALS WILL THE PIPELINE BE TRANSPORTING THROUGH THE AMERICAN HEARTLAND? GIVEN THE SIGNIFICANT POTENTIAL FOR LEAKS AND SPILLS, AND THE FACT THAT THE PIPELINE WILL TRAVERSE CRITICAL DRINKING WATER SOURCES, THE PUBLIC HAS A RIGHT TO KNOW.

In an attempt to answer this question, clean energy advocate and philanthropist Tom Steyer sought the help of a community resident to collect a sample of spilled tar sands crude oil from the March 29 ExxonMobil pipeline rupture in Mayflower, Arkansas. The sample, taken on April 11, was provided to Environmental Working Group roughly two months later to test for the presence of toxic chemicals.

EWG commissioned an independent laboratory analysis, which found that – despite the likelihood of significant off-gassing of volatile chemicals prior to the sample's delivery – the spilled tar sands oil contained seven highly toxic compounds, including lead, benzene and others that can cause cancer and developmental problems. EWG's findings raise new questions about the potential health and safety risks of the proposed Keystone XL pipeline, which would carry 830,000 barrels of tar sands oil daily from Canada across the United States. *(see Table 1 on page 4)*

The seven contaminants found in EWG's testing may be only the beginning, however. Crude oil is known to contain many volatile and semi-volatile chemicals that rapidly disperse into air. Community air sampling conducted directly after the Mayflower spill confirmed the presence of more than 25 toxic chemicals, including the hazardous air pollutants benzene, toluene, ethylbenzene, xylene, hexane and cumene (GCM 2013).

"I couldn't breathe. My throat and nose and eyes were burning really bad.... I could smell that horrible smell. I got really scared."

– Mayflower, Ark. resident

Eight students were sent home from school after the spill because they were vomiting and complaining of headaches (McAllister 2013). Other Mayflower residents complained of nausea, headaches, breathing problems, respiratory problems and

TABLE I

TAR SANDS OIL SPILLED IN MAYFLOWER, ARK. CONTAINED 7 TOXIC CHEMICALS

Chemical name	Potential health effects
Benzene	Known human carcinogen associated with leukemia; exposure during pregnancy may cause birth defects; can also have toxic effects on blood and bone marrow, the nervous system and immune system. (IARC 1982; 1987; 2012; ATSDR 2007a; Lupo 2011)
Toluene	Toxic to the nervous system and kidneys; exposure to high levels during pregnancy may lead to birth defects and other health problems. (ATSDR 2000)
Ethylbenzene	Listed as a carcinogen in California's Proposition 65 inventory of toxic chemicals; animal studies suggest that it may also be toxic to the nervous system, cause developmental harm and damage hearing and the kidneys. (ATSDR 2010; OEHHA 2013)
1,2,4-Trimethylbenzene	A volatile chemical that can irritate the skin and respiratory system; exposure to high levels may cause adverse central nervous system effects such as drowsiness and headache; animal experiments show that it can have toxic effects on development. (EPA 1994, Saillenfait 2005)
Xylenes	Toxic to the nervous system; can cause respiratory irritation; some human studies indicate that exposure may also affect the kidneys and liver. (ATSDR 2007b)
Chromium	A common form (called chromium-6 or hexavalent chromium) is a known human carcinogen and has been shown to cause birth defects and developmental defects in animals. (ATSDR 2012)
Lead	Highly toxic to the developing nervous system; can cause serious and permanent damage to the unborn, including effects on cognition and growth; can affect almost every organ and system of the body and has no known safe level. (ATSDR 2007c)

other symptoms after breathing the fumes; these complaints persisted for days and even weeks after the spill (McAllister 2013, GCM 2013, Peeples 2013). One community resident who lives just outside the evacuation zone described waking up in the middle of the night a couple of days after the spill: "I couldn't breathe. My throat and nose and eyes were burning really bad... I could smell that horrible smell. I got really scared" (Peeples 2013).

The citizen-collected sample provided to EWG was not gathered in a manner that could adequately capture the volatile and semi-volatile chemicals that likely off-gassed from the spilled oil into the surrounding air. Rather than being placed in a special, hermetically sealed container of the kind typically used to transport volatile-containing samples to a lab, the Mayflower oil sample was placed into a plastic food container with a piece of plastic wrap over the top. It was later transferred to an ordinary screw-top jar, which was then given to EWG. In addition, the sample was kept at room temperature rather than refrigerated. Such handling is known to increase the volatilization of chemicals and can make them break down or dissipate faster. Furthermore, EWG received

the sample more than two months after the spill took place, providing significant opportunity for the crude oil to off-gas.

For these reasons, EWG's tests focused on the *presence* of toxic chemicals, not their levels.

Despite the fact that EWG's test results likely represent significant underestimates of the concentrations of volatile and semi-volatile chemicals, the level of benzene found (4.5 parts per million) is still cause for significant concern. This volatile compound readily dissolves in water, and the estimated 3,500-to-5,000 barrels of oil spilled in Arkansas contained enough benzene to contaminate 132-to-188 million gallons of drinking water at levels above the 5 parts per billion limit allowed under federal drinking water standards (PHMSA 2013). Long-term exposure to benzene above this limit increases the risk of cancer and blood problems (EPA 2013a).

TABLE 2

TWO MONTHS AFTER THE MAYFLOWER DISASTER, SPILLED TAR SANDS OIL STILL CONTAINED DETECTABLE LEVELS OF MANY TOXIC CHEMICALS

Chemical name	Concentration* (parts per million)
Benzene	4.5
Toluene	23
Ethylbenzene	7.4
1,2,4-Trimethylbenzene	30
m,p-Xylene	41
o-Xylene	15
Chromium	0.29
Lead	0.31

*Levels are likely to be underestimates due to non-standard sampling methods used by local resident.

The Arkansas spill sample also contained detectable levels of lead, which is toxic at such low levels that the Environmental Protection Agency has set the drinking water goal at zero. A lead-contaminated pipeline spill that came into contact with drinking water supplies would likely pose unacceptable public health risks.

SECRET CHEMICALS IN THE PIPELINE

Because of industry trade secrets, EWG was able to test for only a limited number of potential contaminants in the Mayflower crude oil sample. This constraint also makes it difficult for the federal government to assess the safety of transporting tar sands oil through the Keystone XL pipeline. This could have significant implications for communities along the proposed pipeline route, should there be additional spills into communities, farm fields and waterways. Given that significant pipeline spills happen every three days on average in the United States, it will be only a matter of time before spills take place along the Keystone pipeline route if it is constructed (McAllister 2013).

The pipeline that burst in Arkansas was carrying the same type of Canadian tar sands oil that would flow through Keystone XL, technically termed "bitumen." Because bitumen typically occurs in solid or semi-solid form, it must be diluted with significant quantities of a chemical cocktail before it can be pumped through a pipeline. The resulting mixture is called diluted bitumen or "dilbit." The exact composition of dilbit is anyone's guess since the tar sands industry claims that the identity of the diluting chemicals is a trade secret and does not disclose that information.

"An analysis of potential diluents is important to establish the potential health and environmental impacts of any spilled oil…"

– Environmental Protection Agency

The lack of such basic information was one reason the Environmental Protection Agency gave a rating of "inadequate" to the State Department's draft Environmental Impact Statement on the pipeline proposal. This rating indicates that the EPA did not think the draft document adequately assessed the potentially significant environmental risks of building and operating the pipeline (EPA 2011).

The EPA noted that "an analysis of potential diluents is important to establish the potential health and environmental impacts of any spilled oil, and responder/worker safety, and to develop response strategies" (EPA 2011). Equally importantly, the public cannot make an informed judgment on the safety of the Keystone XL pipeline if it is in the dark about what kinds of toxic chemicals will flow through it.

It is clear, however, that dilbit spills pose a unique and serious environmental and public health threat. The EPA recently emphasized that spills of diluted bitumen "require different response actions or equipment from actions for conventional oil spills" (EPA 2013b).

According to Cornell University soil scientist Corey Ptak, tar sands oil is particularly challenging to clean up and takes a long time to break down in the environment. "Heavy crude oil and crude bitumen from oil sands contain a higher percentage of long-chain hydrocarbons, asphaltenes and resins," Ptak told EWG. "These compounds are highly resistant to microbial actions, making these forms of crude more difficult to degrade than lighter crude oils. As a result, crudes from oil sands will require different management plans and potentially longer time frames to effectively remediate."

A July, 2010 pipeline spill in Marshall, Mich., provided ample evidence of how challenging it is to clean up spills of tar sands oil. In that incident, Enbridge Energy Partners reported that a rupture of a 30-inch diameter oil pipeline had released 843,000 gallons of dilbit into a nearby creek and ultimately into the Kalamazoo River. (The Keystone XL pipeline would be 36 inches in diameter, which would make a similar spill even more devastating.) Heavy oil from the Enbridge spill sank to the bottom of the river and mixed with sediment and organic matter, making the recovery process extremely difficult.

$1 billion – estimated cost of cleaning up Enbridge tar sands oil spill

After almost three years of cleanup efforts, the EPA recently determined that it will be necessary to dredge of the bottom of the Kalamazoo River to "protect public health and the welfare of the environment (EPA 2013b)." A document filed by Enbridge with the US Securities and Exchange Commission (SEC) in March said that as a result of EPA's final order, the estimated cost of cleaning up the spill had risen to a staggering $1 billion (SEC, 2013).

CONCLUSION

EWG's testing of the Arkansas spill sample highlights the risks that the Keystone XL pipeline would pose to water resources, especially in light the EPA's earlier conclusion that pipeline spills are a "very real concern" (EPA 2011). Pipeline ruptures are common: The industry's record makes clear that it's a matter of when, not if. Spills might be especially likely with tar sands oil because it takes higher temperatures and pressures to keep bitumen flowing

than with conventional crude oil.

How many drinking water supplies or acres of farmland might be devastated by pipeline ruptures for months, years or perhaps forever if Keystone XL moves forward?

Over its planned route of 1,179 miles from Alberta, Canada, to Nebraska, the Keystone XL pipeline would traverse a number of critical water resources, including aquifers that provide drinking water to millions who live in the High Plains area of the United States. This includes the Ogallala aquifer, the nation's largest underground drinking water source (Heineman 2013). The proposed pipeline route also crosses 65 rivers, streams and other water bodies designated for drinking water or for recreation, fishing and agricultural uses (USDS 2013).

The Arkansas and Michigan pipeline ruptures are clear warnings of the dangers facing America's waters, soils and homes if the Keystone XL pipeline is approved, as well as a reality check on the incredible difficulty and expense of cleaning up after spills of tar sands oil. Given the industry's track record, it is essentially inevitable that such spills will take place sooner or later in America's heartland if Keystone XL moves forward.

EWG's findings raise crucial questions: How many drinking water supplies or acres of farmland might be devastated by pipeline ruptures for months, years, or perhaps forever? Would people want to buy food from a farm that had been contaminated with crude oil containing benzene, lead and any number of other toxic chemicals? These are difficult questions that deserve serious consideration. This is especially true given that – as the Mayflower rupture demonstrates – pipelines do not fail gracefully. They fail catastrophically.

RECOMMENDATIONS

At a bare minimum:

- Oil and gas companies must be required to publicly disclose the names and amounts of all chemicals used to dilute tar sands oil.
- Oil and gas companies must be required to submit samples of the diluted for thorough independent testing to assess the concentrations of toxic chemical pollutants.
- The State Department must revise its Environmental Impact Statement, which dismissed concerns about the pipeline without taking into account the highly toxic nature of what would flow through the pipe, and address the risks of the chemicals that will be used to dilute tar sands oil flowing through Keystone XL.

REFERENCES

1. ATSDR. 2000. Toxicological Profile for Toluene. Available: http://www.atsdr.cdc.gov/toxprofiles/tp56-c2.pdf
2. ATSDR. 2007a. Toxicological Profile for Benzene. Available: http://www.atsdr.cdc.gov/toxprofiles/tp110-c3.pdf
3. ATSDR. 2007b. Toxicological Profile for Xylene. Available: http://www.atsdr.cdc.gov/toxprofiles/tp71-c3.pdf
4. ATSDR. 2007c. Toxicological Profile for Lead. Available: http://www.atsdr.cdc.gov/toxprofiles/tp13-c3.pdf
5. ATSDR. 2010. Toxicological Profile for Ethylenzene. Available: http://www.atsdr.cdc.gov/toxprofiles/TP.asp?id=40&tid=14
6. ATSDR. 2012. Toxicological Profile for Chromium. Available: http://www.atsdr.cdc.gov/toxprofiles/tp7-c3.pdf
7. California Office of Environmental Health Hazard Assessment. 2013. Current Proposition 65 list. Available: http://oehha.ca.gov/prop65/prop65_list/files/P65single052413.pdf
8. EPA (Environmental Protection Agency). 1994. Chemicals in the Environment: 1,2,4-trimethylbenzene. Available: http://www.epa.gov/chemfact/f_trimet.txt
9. EPA (Environmental Protection Agency). 2011. Public EPA comment letter to US Department of State regarding the Supplemental Draft Environmental Impact Statement from TransCanada's proposed Keystone XL project. Available: http://www.bilateralist.com/wp-content/uploads/2011/06/keystone-xl-project-epa-comment-letter-20110125.pdf
10. EPA (Environmental Protection Agency). June 3, 2013a. Water: Drinking Water Contaminants. Available: http://water.epa.gov/drink/contaminants/index.cfm#Lis
11. EPA (Environmental Protection Agency). 2013b. Public EPA comment letter to US Department of State regarding the Supplemental Draft Environmental Impact Statement from TransCanada's proposed Keystone XL project. Available: http://epa.gov/compliance/nepa/keystone-xl-project-epa-comment-letter-20130056.pdf
12. EPA (Environmental Protection Agency). Last updated June 3, 2013. Water: Drinking Water Contaminants Available: http://water.epa.gov/drink/contaminants/index.cfm#Lis
13. Global Community Monitor. 2013. Independent Air Test at Mayflower Oil Spill Reveal 30 Toxic Chemicals at High Levels. Available: http://www.gcmonitor.org/article.php?id=1672
14. Hannigan JH, Bowen SE. 2010. Reproductive toxicology and teratology of abused toluene. Syst Biol Reprod Med. 56(2):184-200.
15. Heineman, D. 2013. Letter to President Obama and Secretary Clinton from Nebraska Governor David Heineman. January 22, 2013.
16. IARC. 1982. Some industrial chemicals and dyestuffs. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 29.
17. IARC. 1987. Overall evaluations of carcinogenicity: an updating of IARC Monographs volumes 1 to 42. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.
18. IARC. 2012. A review of human carcinogens: chemical agents and related occupations. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 100F.
19. Lupo PJ, Symanski E, Waller DK, Chan W, Langlois PH, Canfield MA, Mitchell LE. 2011. Maternal exposure to ambient levels of benzene and neural tube defects among offspring: Texas, 1999-2004. Environ Health Perspect. 119(3): 397-402.
20. McAllister E. 2013. Insight: Mayflower, meet Exxon: When oil spilled in an Arkansas town. Reuters. April 11, 2013. Available: http://www.reuters.com/article/2013/04/11/us-exxon-spill-mayflower-insight-idUSBRE93A0PI20130411
21. Peeples, L. 2013. Arkansas Oil Spill Health Complaints Emerge In Mayflower. Huffington Post. April 10, 2013. Available: http://www.huffingtonpost.com/2013/04/10/arkansas-oil-spill-health-_n_3045610.html
22. Pipeline and Hazardous Materials Safety Administration. 2013. http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Enforcement%20Notices/420135006H_CAO.pdf
23. Saillenfait AM, Gallissot F, Sabate JP, Morel G. 2005. Developmental toxicity of two trimethylbenzene isomers, mesitylene and pseudocumene, in rats following inhalation exposure. Food Chem Toxicol. 43(7):1055-63.
24. United States Department of State. Bureau of Oceans and International Environmental and Scientific Affairs. Draft Supplemental Environmental Impact Statement for the Keystone XL Project. March 2013.
25. United States Securities and Exchange Commission. Commission File Number 1-10934. Available: http://www.sec.gov/Archives/edgar/data/880285/000119312513117435/d506989d8k.htm