

Madison County Clean Power Coalition
Our View of Creosote-Treated Railroad Crossties
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Executive Summary
(Three Pages)

Creosote

Creosote consists of thousands of different compounds most of which are suspected or probable carcinogens. Acute exposure causes or exacerbates respiratory illnesses, severe dermatitis, or even general organ failure and death. At low, chronic doses, cancer of almost any organ becomes a concern.

Current Complaints

Georgia Renewable Power (GRP) began testing two new biomass power plants in Madison and Franklin Counties in May of 2019. While noise from the plants was immediately a problem for residents two miles away, health and environmental problems were not associated with the two plants until they began burning used creosote-treated railway crossties in the Fall of 2019. A local physician has noted an uptick in respiratory illnesses coincident with the burning of crossties. There has been a fish kill, bee hive collapse, contamination of organic crops, and concern about exposure of livestock. Startup of the plants has sometimes left deposits of soot across surrounding property so deep footprints could be seen in the soot. However, most of these problems have been associated with more frequent fugitive emissions – dust from the crosstie chipping operation, or creosote or tannin leachate in uncontrolled runoff of surface water.

Nine month's of promises and experience with the Madison and Franklin County plants makes it seem unlikely that anything approaching complete mitigation of these problems can be achieved, either with these or future plants. Importantly, there is a serious potential for chronic exposure to creosote from irreducible stack emissions.

Irreducible Stack Emissions

GRP makes five assertions with regard to stack emissions.

1. The temperature at which the crossties are burned completely destroys creosote.
2. Only about 6% of the original creosote remains in 25-year-old crossties.
3. The stack emissions are constantly monitored.
4. The United States Environmental Protection Agency (EPA) has the expertise needed to evaluate the safety of burning crossties and approves burning them in appropriately engineered plants.
5. The U.S. Environmental Protection Agency has ruled that burning as biomass is the most environmentally friendly way to dispose of railroad crossties.

Claim 1: The peer-reviewed, scientific literature on stack emissions from plants burning crossties is surprisingly sparse. This may be attributed to the technical difficulty in measuring components of creosote in the stack effluent. The amount of creosote needed to cause problems is small, and the most common compound in a sample of creosote is often less than 4% of the sample.

GRP claims to have evidence that stack emissions from burning crossties are no different than stack emissions when clean wood is burned. Their data are from a 1992 survey of studies conducted in the mid-1980s. The survey did not have combustion of crossties as a principle interest, and the survey's authors describe the data as sparse. Those sparse data are largely industry self-studies conducted in demonstrably unscientific ways that reach internally inconsistent results. Moreover, we do not have the practical technology, today let alone in 1985, to study stack emissions of creosote. The EPA does not use such studies in rule-making. There are no plans to attempt such studies on GRP's plants. There are no such studies in the scientific literature. A critique of the survey is found in Appendix 1.

However, a peer-reviewed study from 2001 avoids the problem of quantifying trace amounts of compounds in the stack effluent. It does so by burning small samples of creosote-treated wood in the laboratory under conditions comparable to those in power plants and collecting all of the resulting gasses.

We have used the results of this study to model what might happen in one of GRP's plants. We assumed the amount of creosote in the treated wood was the same as that at the surface of a new crosstie. (It is unlikely to be greater.) We then corrected for 1) the creosote concentration profile across the tie, 2) the loss of creosote over 25 years of use, and 3) the destruction of creosote by the plant's oxygenation catalyst. The first two of these corrections were made with data readily available in the peer-reviewed literature. The last was made in accordance with the manufacturer's claimed efficacy.

Finally, we used the relevant EPA model of dispersion in the atmosphere. **The model predicts concerning amounts of creosote in ambient air 15 miles from the plant.** Details are given in Appendix 2.

Claim 2: GRP's claim that only 6% of the creosote in a new crosstie is present after 25 years is ludicrous. There is abundant, peer-reviewed literature covering crossties from many countries and all parts of the rail network. None of these studies find less than 50% of the creosote remaining and typical studies find 75%.

Claim 3: Constant monitoring of some pollutants or their surrogates is required by the Georgia Environmental Protection Division. However, **there are no plans to monitor any component of creosote at any time.** This reflects the difficulty in doing so.

Circumventing the EPA

Claim 4: In developing rules, the EPA makes no effort to determine whether the stack gasses of a power plant contain the kinds of pollutants that might be expected from crossties. Rather it compares the contaminants of new fuels with those of the traditional fuels they will replace. The traditional fuels are natural gas, coal, clean wood, and fuel oil. The EPA's "contaminant legitimacy criterion" requires a new fuel to have lower concentrations of contaminants than the traditional fuel it replaces. Crossties have more contaminants than any of the traditional fuels except fuel oil. Accordingly, the EPA only permitted biomass plants to burn crossties if they were designed to co-fire with fuel oil during normal

operations (i.e. not just during startup and shutdown).

GRP's power plants were originally designed to burn natural gas and “clean” construction and demolition wood. GRP added fuel oil nozzles that will get little use, except during startup and shutdown, in order to be permitted to burn crossties. However, this violates the contaminant legitimacy criterion twice – once by replacing natural gas and again by replacing clean construction and demolition wood with the two most contaminated fuels. It clearly circumvents the intention of the EPA's 2016 rule. (The fuel oil nozzles will likely go unused during normal operation because fuel oil is used to stabilize the flame temperature, but creosote in the crossties will make this largely unnecessary.)

The EPA specifically rejected proposals to allow all biomass plants to burn crossties. Interpreting the 2016 final rule as allowing biomass plants to obtain permission to burn crossties simply by adding fuel oil nozzles offers a simple route to burning crossties to all biomass plants. (As decorations, the nozzles do possess greater magic than Celtic runes in that they make the 2016 rule appear applicable.) A more thorough analysis of the EPA's rationale for their 2016 rule is found in Appendix 3.

Limiting the rule-making process to a comparison of fuel contaminants opens up another risk. Creosote contains relatively large quantities of dibenzofuran, which yields dioxins when chlorinated. The EPA notes that there is not enough chlorine in crossties to constitute a risk. However, we regard the risk as completely undetermined if crossties are co-fired with construction and demolition wood.

Claim 5: The EPA repeatedly makes it clear that disposal of crossties has no place in any rationale for burning them in power plants. “Application of the legitimacy criteria helps ensure that the fuel product is... not simply being discarded through combustion.”

Conclusion

County commissioners, especially in poorer counties, are naturally attracted to the tax dollars these plants offer. However, the commissioners of both Madison and Franklin Counties are in agreement that they regret having supported the building of these plants in their communities. The power plants are health hazards and are not major employers of local citizens.

As more plants are built, the tons of construction and demolition wood needed each day will become more difficult to obtain, increasing the demand for crossties. The EPA has emphasized that states are free to prohibit burning crossties. As other states do exactly that, biomass power plants are set to proliferate in Georgia. It is important to pass HB857 early in the development of this industry to make it clear they must find a way to profitability that does not depend on burning crossties.

Naive investors think of biomass plants as producing renewable energy and as a boon to the environment. Crossties are not a renewable source of energy. They have a larger carbon footprint and are dirtier than coal. Others may think of burning crossties in a power plant as an environmentally sound way to dispose of them. The EPA says loudly and repeatedly *no*. Crossties are contaminated waste that needs to be buried. You do investors in this industry a favor by warning them off crossties before they become further committed.

There is no reason what-so-ever to accept the burning of crossties in Georgia's power plants. All your constituents will benefit from the passage of HB857.

Questions may be directed to Dr. David Vogel at (678) 840-2000 or noslogans@charter.net.

On behalf of the Madison County Clean Power Coalition,

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Appendix 1

A Critique of “Evidence” That Creosote Is Completely Destroyed

GRP claims that the emissions from a plant burning creosote-treated railroad ties (C&D) are not different from the emissions of a plant burning clean wood. The claim is based entirely on a survey commissioned by the EPA and completed in 1992 (Atkins and Donovan, EPA Cooperative Agreement CR815271). The evaluation of C&D was not a principal goal of the survey, it was incidental to an attempt at broadly describing wood-burning power plants. The studies were in no way coordinated, and the data collected varied from plant to plant. Of 46 plants from which some data was collected, only four burned C&D. Most of the data were collected by industry groups with their attendant biases.

The difficulty in quantitatively determining the amount of a gas in the stack effluent is illustrated by GRP's own applications for various permits. The applications require GRP to estimate the total quantity of all volatile organic compounds (VOCs) their plants will emit. These VOCs include the hazardous gasses that might be released from creosote, as well as other gases from wood, natural gas, or fuel oil.

When GRP first applied for permission to burn construction and demolition wood (C&D), they estimated total VOC emissions at 47.7 tons per year. When they applied for permission to burn C&D, they again estimated 47.7 tons per year. However, when they applied for permission to burn other railroad ties, their estimate went up to 199.8 tons per year. What changed? Nothing except the method they expected to use to measure total VOCs.

To measure a particular compound characteristic of creosote is even more difficult. The most common compound in a sample of creosote is often naphthalene, but the naphthalene is typically only 3 to 4% of the sample. As small amounts of creosote are highly toxic, measuring the amount of naphthalene as a proxy for the total amount of creosote in the stack gases is difficult. No effort is planned to measure any compound characteristic of creosote in the stack gases of GRP's power plants.

The authors of the study GRP cites acknowledge that the data for all kinds of treated wood is sparse, “Few sources of emissions data were available on combustion of C&D, railroad ties, telephone poles...” Accordingly, the authors tend to consider treated wood as all of a kind.

Studies of the four plants that burned C&D looked for a total of three compounds relevant to creosote – naphthalene, benz[a]pyrene, and benz[a]anthracene. Naphthalene is normally present in relatively large quantities in raw creosote and is found in comparably large quantities in the gases emitted when creosote-treated wood samples are burned in the laboratory. Accordingly, it is a logical compound to study in any attempt to evaluate possible creosote pollution. Aside from naphthalene, only benz[a]pyrene, and benz[a]anthracene were studied. Neither are among the major compounds evolved when burning creosote in the laboratory study cited in Appendix 2. The results from the four plants follow.

The study of the first plant (Ultrapower) did not include any compounds relevant to creosote.

The study of the second plant (Bayfront) attempted to analyze only benz[a]anthracene and did not find it at detectable levels.

The study of the third plant (Blandin) attempted to analyze all three compounds and found low

concentrations, probably not of concern, of both benz[a]pyrene and benz[a]anthracene. Doubts concerning the study may be raised by the failure to detect naphthalene.

The fourth site (named “Site Five”) again failed to look for naphthalene and did not find the other two compounds at detectable levels.

None of these studies could be described as “scientific.” None of the studies describe their sampling method, or the sensitivity and accuracy of their analytical methods (which we would not expect to be good in 1985). The composition of creosote is variable, depending on its source, and none of the studies attempted to determine the composition of what was being burned. None of the studies appeared in a scientific journal, though there were journals that certainly would have been interested in publishing the results.

Summary

The aging survey that GRP relies upon to support their claim that creosote is completely destroyed in the boiler fire only serves to emphasize the difficulty in analyzing stack gases.

Appendix 2

A Model of Creosote Stack Emissions from the Madison County Biomass Plant

Data for the following model is found in Becker et al., Journal of Analytical and Applied Pyrolysis 57 (1) 2001 (simply “Becker,” below).

Confronting the difficulty in measuring stack emissions, Becker resorts to burning samples of creosote-treated wood weighing only about 50 milligrams. The samples were burned under power plant conditions simulated in the laboratory. The laboratory setting allows all the emerging gases to be captured and analyzed quantitatively.

Fourteen compounds found in relatively large quantities in the raw creosote used to treat the wood were first analyzed quantitatively. Collectively they amounted to 35.3% of the raw creosote.

When gases produced from burning creosote-treated wood were analyzed, all of the major components were volatilized creosote (except phenol which is not a large component of raw creosote). Burning clean wood produced almost none of these gases with the exception of phenol. The amount of phenol produced was about half that produced from creosote-treated wood suggesting that phenol is a combustion product of both creosote and wood. In the following calculations we exclude the amount of phenol attributable to the wood. (The calculations are unchanged if we ignore phenol entirely.) Wood also produced a small amount of naphthalene, just at the limit of detection, and is ignored in the following calculations.

Roughly 50 milligram samples of treated wood were burned at 750 °F, 1125 °F, and 1500 °F. At each temperature the evolved gases were analyzed, and the masses of the same 14 compounds as were analyzed in raw creosote were determined. The total mass of all of the 14 compounds at each temperature is given below in milligrams of gas per gram of treated wood burned.

750 °F	36.5 mg/g
1125 °F	29.7 mg/g
1500 °F	30.4 mg/g

The values at 1125 °F and 1500 °F were not significantly different. In general, the amount of each volatilized gas present was proportional to the amount present in raw creosote.

Most of the compounds present in creosote are polyaromatic or heteroaromatic compounds that combust by similar mechanisms, and it is a reasonable to assume the 14 compounds that comprised 35.3% of the raw creosote also comprised approximately 35.3% of the vaporized creosote that survived the flame. Accordingly, the total amount of creosote evolved is given by

$30.4 \text{ mg/g} / 0.353 = 86.1 \text{ mg/g}$ total volatilized creosote at 1500 °F. (Still to be corrected downward.)

Let us assume the concentration of creosote in the treated wood was the same as the concentration on the surface of a new crosstie. (Given the pressure treatment of crossties, it is unlikely to have been more.) A new crosstie has a lower concentration at the center than at the surface. The concentration gradient in new crossties has been well studied, and we can conclude that the average concentration is at least 85% of the surface concentration. (There is more wood near the surface than near the center which still has 50% of the creosote of the surface.) Accordingly, we make the following correction.

$$86.1 \text{ mg/g} \times 0.85 = 73.2 \text{ mg/g}$$

The concentration of 25-year-old crossties is at least 50% of the concentration of new crossties. So the creosote evolved from a 25-year-old sample would be at least

$$73.2 \times 0.5 = 36.6 \text{ mg/g}$$

This is the amount of creosote we expect to emerge from each gram of crosstie burned. However, there is a caveat. According to Steve Dailey, President and CEO of GRP, the plant burns at an average temperature of 1800 °F, which is 300 °F hotter than the laboratory temperature. The temperature can make a difference in the rate of oxidation of a compound. However, we notice little difference between the laboratory values at 1125 °F and 1500 °F. This is expected at temperatures so high that collision energies greatly exceed the activation energy of a reaction. Accordingly, we expect only a small reduction in the surviving gases between 1500 °F and 1800 °F. Moreover, the sample size is much smaller than that found in a power plant, the dwell time for oxygenated gasses passing over the burning wood was much longer than in a typical power plant, and the sample was continuously well oxygenated – all of which tend to promote oxidation.

The plant is permitted to burn 8.75 tons of crossties per hour. GRP is unlikely to burn less because they need the creosote for flame stability. Accordingly,

$$36.6 \text{ mg/g} \times 907185 \text{ g/ton} \times 8.75 \text{ tons/hour} = 291,000,000 \text{ mg/hour} \text{ (291,000 g/h)}$$

According to the manufacturer, the plant's oxygenation catalyst will destroy 55.6% of the

creosote released from burning.

$$291,000 \text{ g/hour} \times (1 - 0.556) = 129,000 \text{ g/hour}$$

$$129,000 \text{ g/hour} / 3600 \text{ sec/hour} = 35.8 \text{ g/sec}$$

GRP appropriately uses the EPA's Screen 3 dispersion model to determine ground level exposures. Data for the model, other than the rate of creosote release, is taken from GRP's permit applications.

The maximum estimated concentration in the ambient air at 1 meter above the ground is found at a distance of 1000 m (0.6 miles) from the stack. The concentration is 0.061 mg/m³. At 25,000 m (15 miles), the concentration is still 0.021 mg/m³.

To understand the potential health effects we note that the National Institute for Occupational Safety and Health recommends a maximum occupational exposure for a 40 hour week of 0.1 mg/m³. This might be converted to a maximum exposure for a continuous, 168 hour week.

$$0.1 \text{ mg/m}^3 \times 40 \text{ hours} / 168 \text{ hours} = 0.024 \text{ mg/m}^3$$

Summary

This model estimates that the Madison County biomass power plant, burning crossties at its permitted rate, will cause creosote pollution in the ambient air comparable to the scientific recommendation for maximum occupational exposure as far as 15 miles from the plant. Other recommendations (e.g., OSHA's limit of 0.2 mg/m³) represent agreements negotiated with industry, but still suggest unacceptable contaminant levels at considerable distances. We are unaware of any recommended exposure limit for the general public. However, such recommendations are typically far below the occupational limit. **Accordingly, we find that, even if the model drastically over-estimates the actual exposure, volatilized creosote represents a significant health threat many miles from the Madison and Franklin County plants.**

Appendix 3

Circumventing the EPA's Rationale

There are four traditional fuels used in power plants: coal, natural gas, fuel oil, and clean wood (not including "clean" construction and demolition wood). Of these, fuel oil contains by far the most contaminants (pollutants). Non-traditional fuels may be burned if it is demonstrated to the EPA that these fuels are equivalent to the fuel they replace in all respects and have equal or lower concentrations of individual contaminants. In 2011, the EPA began classifying some such non-traditional fuels as "categorical non-waste fuels." This classification allows power plants to burn them without going through a complex, individual, special-permitting procedure.

Biomass power plants that burn, for example, clean wood generally may also burn a fossil fuel in order to maintain a high enough flame temperature. Some such plants co-fire with natural gas or coal, others with fuel oil. As creosote is a fossil fuel, biomass plants that are permitted to burn CTRTs

have little or no use for additional fossil fuel (except during startup and shutdown).

Accordingly, in 2012 an industry coalition petitioned the EPA to include used CTRTs as categorical non-waste fuel. For the most part, EPA said *no*.

In 2014 the EPA proposed a rule that would permit biomass plants designed to co-fire with fuel oil during normal operations and not just startup and shutdown to burn crossties. The rationale for doing so is complex. It is made complex by the EPA's own rule which states that a new fuel should be lower than the traditional fuel in each individual contaminant – the “contaminant legitimacy criterion.” Part of the rationale is as follows:

CTRTs are more contaminated than fuel oil with respect to nitrogen and fluorine . So CTRTs cannot be burned in a plant designed to burn only fuel oil. CTRTs are more contaminated than clean wood with respect to volatile organic compounds (VOCs). So CTRTs cannot be burned in clean wood biomass plants. However, they are lower in VOCs than fuel oil and lower in fluorine and nitrogen than clean wood. So the EPA determined that they can be burned in plants that co-fire clean wood and fuel oil.

We find this argument to be perverse. The CTRTs in such a plant are either replacing fuel oil, in which case they are more polluted with nitrogen and fluorine, or they are replacing clean wood, in which case they are more polluted with VOCs. However, we have no objection to the argument because it reaches a desirable end. The problem with VOCs in fuel oil is much worse than the problem with nitrogen and fluorine in CTRTs, and we are happy to see the most contaminated traditional fuel replaced by CTRTs even though CTRTs are worse than any other traditional fuel.

Responding to comments to the 2014 proposed rule, the EPA specifically rejected proposals that suggested expanding the rule to allow burning CTRTs in all biomass plants. In every case, they reject the proposals as being in violation of the contaminant legitimacy criterion.

The problem, now, is that the Georgia Environmental Protection Division interprets the Final Rule, approved in 2016, as allowing any biomass plant to gain permission to burn crossties by installing fuel oil jets – fuel oil jets that could go unused in normal operations once permission to burn crossties is granted. In GRP's case, this circumvents the EPA's intention by replacing two clean fuels with two dirty fuels, violating the contaminant legitimacy criterion twice.

We would argue that a correct interpretation of the 2016 rule would consider the transformation of a plant, not just the end result. GRP's plants were designed to burn natural gas and wood. They were then decorated with fuel oil nozzles to obtain a permit to burn crossties. The plant is still nothing but a plant designed to burn natural gas and wood requesting permission to burn crossties.

Out of concern that their rule would discourage plants that burn fuel oil from converting to cleaner natural gas, the EPA promulgated an additional rule. This rule permits plants that already burn fuel oil and clean wood to switch to natural gas without losing permission to burn crossties. The EPA writes, “The Agency emphasizes that the approach described above is meant to address only the current circumstance where contaminants in [crossties] are... less than in the traditional fuels the unit was designed to burn... The approach is not a general means to circumvent the contaminant legitimacy criterion...”

It seems unlikely that the EPA would write a rule intended to permit a plant to switch in the opposite direction from natural gas to fuel oil in order to burn crossties.

The only reason EPA could have for allowing a power plant to substitute more contaminated fuels for less contaminated fuels would be as a means to dispose of the more contaminated fuels. The EPA explicitly rejects disposal as any part of a rationale for burning any fuel in a power plant. The EPA writes, “Application of the legitimacy criteria helps ensure that the fuel product is [not] being discarded through combustion.”

Finally, the rationale for the EPA's 2016 final rule is, itself, deeply faulty and the rule should be abrogated. It is not just a matter of the perverse argument discussed earlier that allows the EPA, itself, to circumvent the contaminant legitimacy criterion.

In order to successfully argue for making crossties a categorical non-waste fuel, the EPA had to change its method for comparing contaminants in different fuel sources. Previously, numerous values for the amount of each contaminant in each fuel were obtained from various sources. Contaminants were compared in terms of their respective ranges of values. More importantly, they were also compared in terms of their 90% Upper Prediction Limit (UPL). The 90% UPL is a statistic that estimates a contaminant level that 90% of measured values will fall below. When comparing fuels, the one with the lowest 90% UPL appears to be the least contaminated. Even in the 2016 final rule, this statistic is used to compare clean wood with clean construction and demolition wood. However, it is not available for comparing crossties to traditional fuels.

For comparison of crossties with traditional fuels, the EPA abandoned the UPL, using only the range of values. As no one is much interested in the lowest contaminant level, abandoning the UPL means that the EPA only compared the most contaminated sample out of all their data on crossties with the most contaminated sample for each of the traditional fuels. This is unacceptable on three grounds.

First, they can be expected to be comparing outliers that have no relevance to the expected contamination of each fuel.

Second, as they have many more data points for traditional fuels than for crossties, there is a greater probability of there being an extreme outlier among traditional fuel samples than among crosstie samples. Such an outlier would make crossties look less contaminated when they are not.

Finally, there is a realistic fear that the comparison is being made between two laboratory errors.

The EPA offers no explanation for abandoning the UPL. The only reasons that come readily to mind are 1) that they have insufficient data to calculate a UPL, in which case they have insufficient data to reach a conclusion, or 2) that the UPL does not support the conclusion they want to reach.

Summary

We do not blame the EPD for applying what we find to be a superficial interpretation of the 2016 final rule. They may not have the resources needed to do otherwise. Accordingly, it is important for the legislature to express the intention of the State of Georgia to prevent the substitution of dirty fuel for clean fuel in our power plants.