Thermolyzer & Crossties: A Convenient Opportunity

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Thermolyzer Pilot Plant

In the summer of 2018, CHZ Technologies became aware of a problem facing the industry with the disposal of scrap crossties. This problem has been exacerbated because many of the cogeneration plants have converted to natural gas to power the plant rather than using other feedstocks like crossties. Therefore, we believe that the door is open for a possible alternative solution for the safe disposal of scrap crossties.

During that summer timeframe, CHZ Technologies explored a solution that may safely dispose of used crossties and deliver a salable byproduct as well as energy. This technology is called Thermolyzer.

Our 7 ton/day pilot plant in Forst (Lausitz), Germany, is shown above. It is a third-generation gasification technology that is unique among all other gasification technologies. It can accept all types of feedstocks such as wood, tires, plastics, polymers, auto shredder residue, composites and electronic wastes.

Thermolyzer converts organic material in the feedstock into a clean synthesis gas and a salable byproduct called "char." It is indirectly heated, so no flame reaches the feedstock. The resulting synthesis gas is made up of C1-C4 aliphatic hydrocarbons, hydrogen, CO, and CO2 that has been scrubbed clean of any impurities. About 20 percent of the produced gas is used to operate the unit.

This syngas is so clean that has been certified for use in gas turbines and IC engines to generate electricity. Of course, it can be used directly in gas burners to provide clean heat for industry processes. The emissions from the Thermolyzer system meet stringent emissions standards like in Germany, California and other U.S. states.

The energy content of the syngas from each feedstock is different, and the salability of the char is also different. For example, with tires as a feedstock, the syngas has an energy content very close to that of natural gas, and the char consists mainly of carbon black and steel.

However, an additional benefit is the char that remains from the crosstie feedstock, called "biochar," can be sold into a range of markets that are very profitable. The biochar market in the United States ranges upward from 50,000 tons/year.

Presently, processors supply the market using materials like animal wastes, sewage sludge, agricultural wastes, municipal solid wastes, forest scraps, and hard and soft woods.

Each feedstock produces somewhat different biochars with different impurities (some beneficial) and variable properties. The applications of biochar include wastewater purification, filtration media, agricultural crop moisture retention, and soil nutrient enhancement. The use of biochar in the agricultural market has shown increased crop yields and healthier plants, but results are soil dependent and there are other factors.

From our industry survey, the major markets appear to be crops, filtration and odor control. It also appears that the market would profit from biochar produced from a consistent feedstock, and hardwoods like oak provide the best biochar. Therefore, scrap crossties appear to be an ideal feedstock. Because many of the current producers of biochar produce less than 100 tons/year and only five produce more than 5,000 tons/year (~20 tons/day), there is also a need for a large-volume producer that is producing a consistent biochar. Once again, scrap crossties seem to meet that need.

Based on this analysis, CHZ Technologies processed about one ton of scrap crossties and utility poles in our pilot plant in Forst. The primary purpose of the test was to show that a clean biochar could be produced from crossties (containing no dangerous polyaromatic hydrocarbons (PAHs) or PCBs, polychlorinated biphenyls) and to evaluate some physical properties of the biochar.

Test temperature conditions were based on our best estimate of the conditions needed to maximize the amount of biochar with good properties. We knew that crossties contain creosote plus other preservatives such as borate. Other approved preservatives are copper naphthenate and pentachlorophenol, but these are rarely used. The good news is that we can safely process and dispose of all these other preservatives and have a clean, safe product.

The photo to the right shows the biochar we produced. We had it analyzed as well as the biochar from the utility poles and noticed some interesting results. The expected good news was that we had destroyed all the creosote, and the PAHs were at a level below International Biochar Initiative (IBI) standards. The PCBs were not present at the limits of detectability.

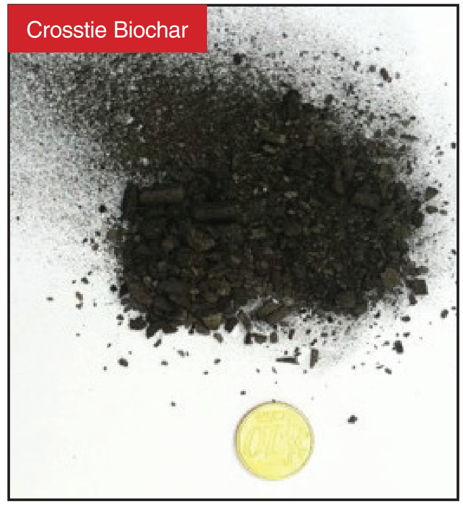
The other good news was that the energy content of the syngas from crossties was about 420 Btu/ft3, which is higher than the syngas created from other woods like pine or ash wood. It also about half that of natural gas or the syngas from scrap tires. Processing 100 tons of crossties in a Thermolyzer plant would produce approximately 3 MW of electricity each day. This is enough to run much of the electrical needs of a manufacturing facility.

However, then we got a surprise from both analytical laboratories: both of the samples expected to be solely from crossties and the samples expected to be a mix of utility poles contained trace amounts of arsenic, iron, lead, zinc and copper. While in the case of crossties the amounts were minimal, both samples were above IBI limits. Some of these elements can be beneficial to crop growth but lead and arsenic are not. We believe the lead came from solders left over in the Thermolyzer from processing electronic wastes. The arsenic could only have come from contamination of the crosstie samples with some amount of utility poles.

Therefore, what we thought was a homogenous mix of only creosote-treated crossties was crossties mixed with utility poles. Interestingly, our analysis of the materials prior to the Thermolyzer process showed all the 15 tested elements, except As, were below IBI limit concentrations. Thus, we will go back and test a new sample of only crossties and confirm we can produce a clean salable product.

Finally, we evaluated the biochar and found it had a lower than expected surface area such that it could be sold for about \$300/ton. By upgrading this material with a simple, existing commercial process, it could be sold for more than double that price. Our assessment of the economics of using Thermolyzer to create a quality biochar are exceptionally positive with paybacks on the order of two to three years depending on biochar quality.

In summary, the Thermolyzer technology was used to convert scrap crossties and utility poles into a biochar and a clean syngas. This syngas can be used to generate electricity or provide process heat for a company. Locating the plant on company property likely would provide energy to the plant at a cost lower than that of the local utility. Such a solution would be attractive for the safe, clean disposal of scrap crossties and delivery of energy to the company. The additional revenue of the sale of biochar would significantly sweeten the opportunity.


Crosstie Biochar

We believe the results of this test show that the Thermolyzer technology is an attractive option that can solve a huge problem facing the industry. We are working collaboratively with the industry to advance the disposal of scrap crossties to the benefit of the nation.

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