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Climate Change Connections

"GREEN" INCINERATION

GREEN is this year's black. At least that is what any fashion conscious person might say. If you read any of the fashion magazines, you'll quickly realize that each year there is a new color that is all the rage, good enough to provide an alternative to the always stylish black. Although I don't pay too much attention to clothes, it is pretty clear that for all walks of life, anything that has even a tangential relationship to the environment or environmental stewardship now wears a "green label." And if it has that green tag, it has to be a good thing.

I am amazed at all of the activities that are now accompanied by the green label. They even go as far as burning organic residuals like municipal biosolids and calling that green energy. But wait, burning biosolids used to be called incineration, not green energy. And burning biosolids used to be a disposal option. And disposing of biosolids used to be a waste of a resource. I thought using the resource was the green option whereas burning would be a grey (not trendy or environmentally correct at all) option. What has changed? How come the color switch? Well, a short answer is that, according to many consultants, new and improved technologies are being used to capture the energy value of biosolids efficiently enough that these materials are a viable source of green fuel.

When I first heard this, I was furious. My initial take was that here were a bunch of shysters selling green incineration to municipalities who were desperate to come up with an alternative to failed or failing land application programs. I will also admit that part of this reaction may have stemmed from the fact that for the last 17 years, my professional life as a soil scientist has centered around beneficial land application of biosolids. But times are different than they were 17 years ago. We as a world need to think about things sustainably. Finding alternative "green" sources of energy is a big part of that challenge.

REVISITING BIOSOLIDS' BENEFITS

This suggests that this is an appropriate time to revisit our initial view of the benefits of biosolids primarily being an alternative source of plant nutrients for agronomic crops. In addition to nitrogen and phosphorus, biosolids also contain carbon — greenhouse gas neutral carbon from the short term energy cycle. And when you burn carbon (i.e., break organic carbon bonds), you release energy. Perhaps the energy value of that carbon is sufficient to make incineration, excuse me, green energy from the biosolids more valuable than the fertilizer content which is generally lost (all of the N and much of the P is rendered unavailable) in combustion. The question for biosolids then becomes: Fuel or Fertilizer?

So I started to read about green energy from biosolids as well as from other organic feedstocks. I read that biosolids have the equivalent energy to brown coal. I read that the Btu value of the material is highest before anaerobic digestion but that dewatering is also much harder at that stage. An important rule of thumb is that the Btu value of 1 kg of anaerobically digested primary sludge is 11,000. And the energy required to evaporate 1 kg of water is 4750 Btus. I read that technologies have improved and that there is now a range of options for combustion including pyrolysis, where the dried material is burned without oxygen. This type of combustion produces a type of synthetic fuel in addition to char and gas. I also read that, with other combustion technologies, the residue from burning biosolids can be used for concrete production, and to make bricks or a slag-like product that can be used for a range of construction applications.

Burning biosolids is tricky because of the way water is "complexed" in the organic fraction of the biosolids, resulting in three distinct stages of loss of water during heating. I also learned that one innovative technology includes mixing oil with the biosolids under high pressure and temperature as a means to separate the water from the biosolids more efficiently. Because of these technological advances, biosolids incineration can sometimes be an energy neutral or even net positive practice with occasional beneficial uses for the residuals. Learning all of this has led me to conclude, at least before I read some more, that burning biosolids is not the absolute evil that I had previously assumed it was and that there are even some redeeming aspects to this practice. However, this neutrality does not take into account the costs of facility construction.

FUEL AND FERTILIZER

But if energy recovery is really your goal, is combustion the best route? For treatment plants in the U.S., anaerobic digesters are a standard part of the treatment process. For a material that is >90 percent water, anaerobic digestion with gas capture is the clear way to most efficiently capture the energy potential. A study out of the University of California, Davis on agricultural wastes concluded that combustion made sense only when moisture content of the feedstocks was < 50 percent and that for the wetter materials, anaerobic digestion was the most efficient means to recover green energy. That would seem to apply to biosolids as well. And if you focus on anaerobic digestion for energy recovery, you still have the N and P in a concentrated form to use for fertilizer. Sort of like having your cake and eating it too.

Perhaps this emphasis on green energy from biosolids via combustion, though improved over years past, is still not the best use of this resource. Awarding biosolids management a green label suggests we capture as much of its value as possible. That means both the carbon value and the fertilizer value. For me, anaerobic digestion with energy capture followed by land application is still the best way to do that. ■

Sally Brown — Research Associate Professor at the University of Washington in Seattle — is a new member of BioCycle's Editorial Board, and will be authoring this regular column on the connections of composting, organics recycling and renewable energy to climate change. E-mail Dr. Brown at slb@u.washington.edu, or Nora Goldstein, Executive Editor, noragold@jgpress.com.