April 3, 2014

Minnesota Composting Council
Ginny Black, Chair
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Dear Ginny,

Thank you for your questions about composting. I would like to start with some background, history and definitions about compost and composting and then I will compare some of the fundamental differences between composting, and landfills.

Growing healthy plants begins with healthy soil. Healthy soil is made up of the correct balance of minerals, water, organic matter, plant nutrients, structure, air space, pH, microbial communities, plants and animals. This balance is sometimes described by the physical, chemical and biological properties of each soil. The USDA has defined and described about 114 major soil types in the State of Minnesota. Organic matter is a key component of all fertile soils.

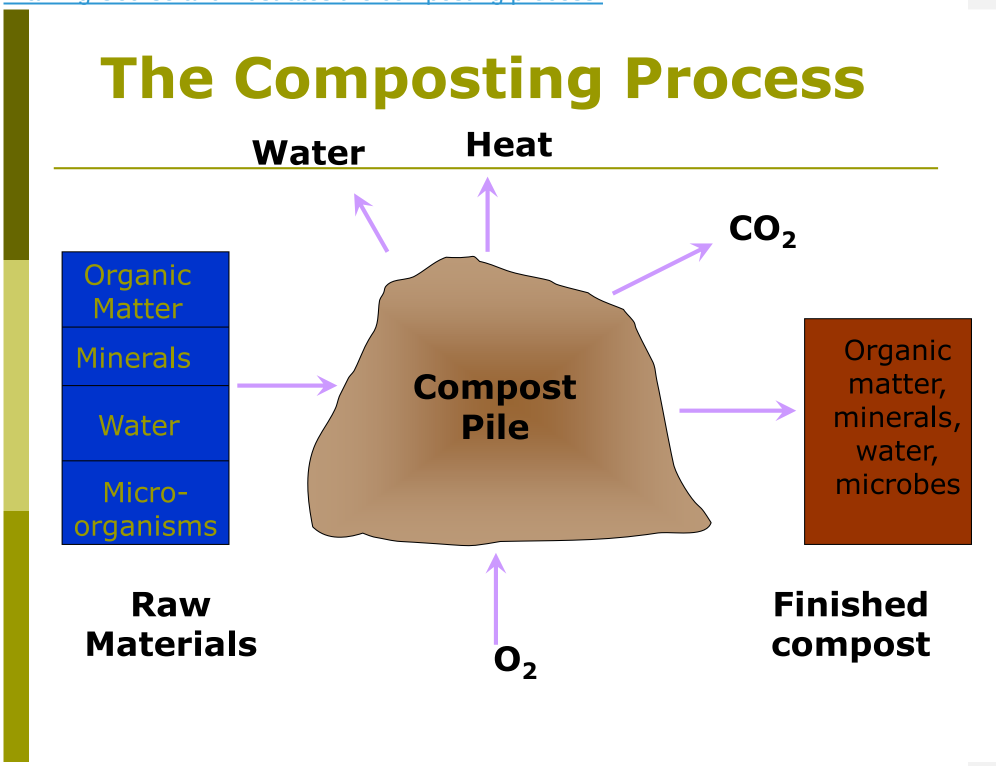
Organic matter is material that comes from living organisms and from once-living organisms including plants and animals. When living plants and organisms die their tissues go through a process of decay. This process changes the properties of the material and results in cycling CO_2, H_2O and producing more stable organic compounds such as Humic acids, Fulvic acids, and Humin. There are several different types of decay processes. Composting is one of these processes.

You asked me "What is Composting, why does it happens, and how does the process flow?

Composting is primarily a biological process whereby microorganisms break large organic molecules into smaller, simpler molecules and synthesizes new complex organic materials. It is preformed under primarily aerobic conditions that results in inactivated weed seeds and pathogens by self heating caused by microorganisms oxidizing carbon and giving off CO_2, and H_2O. It requires the deliberate management of environmental conditions to encourage the growth and development of microbial communities that excel in these processes.

Composting is a primarily a dehydrating environment because moisture is carried away in the hot process gases. Water loss is greater from theis heating process and gas exchange than the amount of water produced from organic decomposition (Haug 1993). Unlike sanitary landfills, where a "hydraulic head" is present a large percentage of the time, w~~W~~ith proper management there is no “permanent hydraulic head” under compost piles~~ as there is under sanitary landfills~~. In fact most compost systems required the addition of~~added~~ water to function properly as there~~n~~ can lose up to 50% of their water in 24 hours at 65.6 degrees C with atmospheric air exchange sufficient to balance oxygen needs of the microbes (Haug 1993). Water is lost in this process from the compost pile into the air.

The diagram below is a diagram I use when teaching the Midwest Compost Operator Training Course and illustrates the composting process.



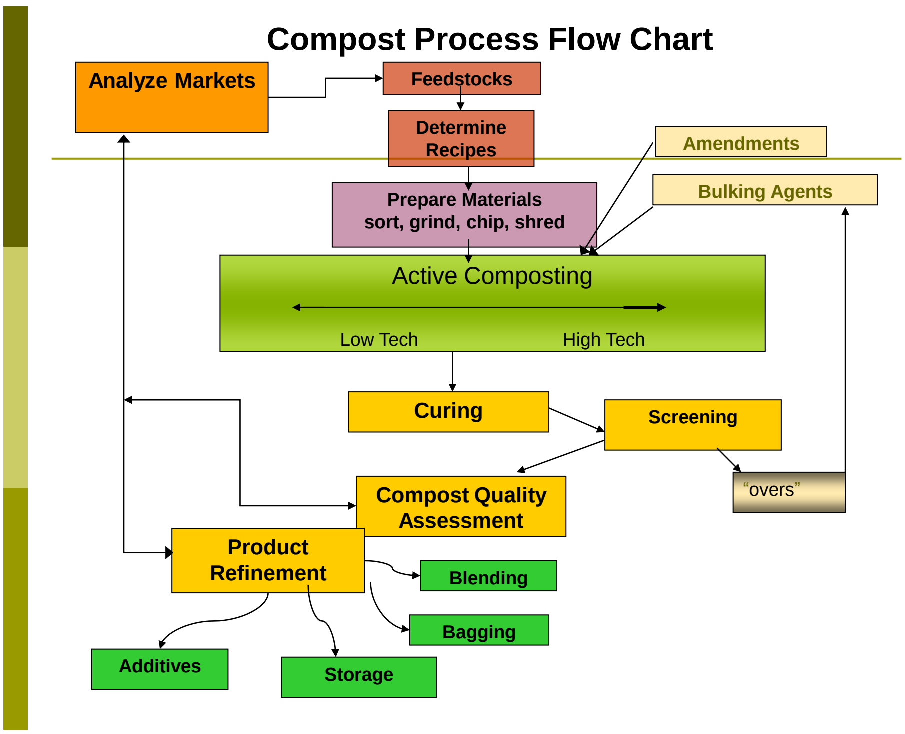
In contrast we have had “sanitary landfills” in the USA for only 55 years. The American Society of Civil Engineers did not publish its guide to sanitary landfilling until 1959. The long term assessments of the environmental impacts and full costs of sanitary landfills is only it its infancy. The engineering standards for sanitary landfilling are based on "containment" for a 30 year post closure time period. It will be interesting to learn if current sanitary landfills will have a sustainable life measured in millenniums?

Here are some additional important differences: Landfills are based on anaerobic (without Oxygen) conditions and composting is based on aerobic (with oxygen) microbial conditions. Landfills produce methane (which has over 20 times the greenhouse gas potency than CO_2), hydrogen sulfide compounds and a wide variety of VOCs. Compost produces carbon dioxide, water, microbes and compost. Landfills accept many dangerous chemicals that source separated composting facilities actively excludes.

Landfills generate leachate and usually have a "permanent hydraulic head" trying to move through liners into groundwater. Composting losses water to the atmosphere and ~~usually~~ is a drying process with a hydraulic dynamic that moves up and out of the compost pile as a vapor, not down into soils.

Landfills and composting facilities use fundamentally different technologies and Best Management Practices. Rules developed for landfills simply cannot be applied to composting facilities. You would never suggest that landfills need to meet incinerator rules. They are different technologies and so are landfills and compost facilities.

A typical operation at a compost site consists of a series of production stages. Much like any ~~product~~ manufacturing process, the raw feedstock materials must first be collected ~~before it is~~and transported to the compost facility, inspected inappropriate materials removed~~graded~~, ~~processed~~mixed to obtain the proper C:N ratio, moisture, and range of particle size, and placed in windrows for compostin~~e~~g~~d~~. During the composting process, the windrow is ~~C:N ratios, moisture content, range of particle sizes, mixing, pile building,~~ aerated through a static or active turning process and temperatures are monitored to assure that the process to further reduce pathogens (PFRP) is meet~~monitoring~~. After composting process the material must be screened and checked for quality before it is sold, distributed and used successfully. To assure that the best available technology is used and that the efficiencies are maximized, each stage of the production should be independently measured and analyzed. This allows the manager to constantly improve the system (Tyler 1996).



It is important to point out that the current MPCA composting rule does not allow the placement of the tipping/mixing and processing area directly on top of soils. Compost sites MUST be on a drive-able all-weather surface of a minimum of one foot of compacted gravel or more. This requirement essentially places a pad with limited permeability under that tipping/mixing and processing area and must be acknowledged as another barrier to contact water reaching ground water. ~~as it is a part of the operational rules.~~

There have been several great advances in our knowledge and operation of compost facilities. The most important was the adoption of the scientific methods to better understand the specifics of compost biology, chemistry, and physics through careful measurements and observations (Gotaas 1956; Golueke 1973; Richard 1996; Epstein 1997; etc.). The second was the application of engineering principles to the design and operation of compost facilities (Gotaas 1956; Finstein 1986; Haug 1993; etc.). The third was that the management of wastes would require both public health and environmental regulations if they were to be permitted (Gotaas 1956; WHO; UN Environmental Program; US-EPA; etc.). The fourth is the recognition that resource allocation optimization is extremely important for both private sector and government compost operations (Tyler 1996; Leege 2002; etc.). Compost rules have a direct effect on resource allocations and on the amount of organic material that will be actually composted and returned to soil environments.

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United Nations Environment Programme
http://www.unep.org/

U.S. Composting Council
http://www.compostingcouncil.org/

University of Duisburg Essen
http://www.uni-due.de/abfall/essen/fachgebiet_en/de/

Waste Management
http://en.wikipedia.org/wiki/Waste
http://en.wikipedia.org/wiki/Waste_management#Biological_reprocessing

World Bank
www.worldbank.org
http://www.worldbank.org/projects/P090376/gef-shanghai-agricultural-non-point-pollution-reduction-project?lang=en&tab=overview

World Health Organization
http://www.who.int/en/

http://apps.who.int/iris/handle/10665/41665

I hope that you find this information useful.

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