

MESOPHILIC STORAGE AND REDUCTION

At the University of Dalat a study was conducted to determine the composition of residential waste. The study was conducted over a period of 50 days, and it focused on the waste of 101 inhabitants from 21 households. Not all residential waste in Vietnam has this composition, but biodegradable waste (henceforth called bio-waste) is always the largest component:

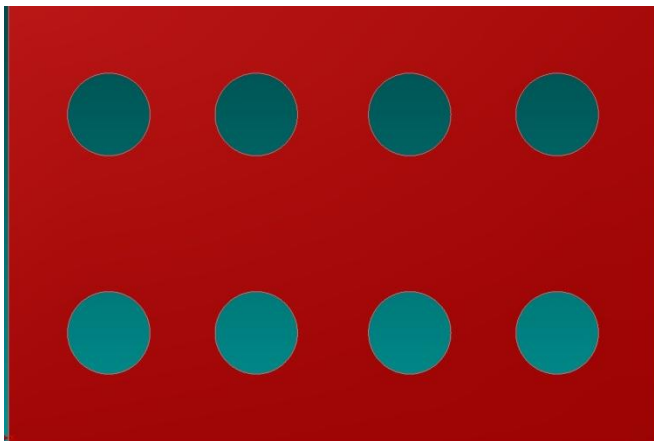
1. food waste	54.02%
2. garden and plant waste	27.76%
3. non-recyclable waste paper	<u>3.63%</u>
total bio-waste	85.41%

In view of such findings, one cannot help but conclude that what is needed is a mesophilic storage and reduction unit that would be installed at each household where space permits. Gone is the costly burden of collecting, transporting, dumping or land-filling bio-waste each day. Instead it would have to be collected but once every year or two, and the residue collected would represent but a small fraction of the original weight and volume of the waste.

This storage unit, however, has to be designed with certain constraints in mind:

1. it must be fabricated out of durable materials that last indefinitely;
2. it must be relatively inexpensive,
3. it must be well aerated;
4. it must not smell or attract flies;
5. it must be heavy (hard to steal) and of little recycle value (not worth stealing);
6. it must effectively keep out dogs, rats, mice and other creatures;
7. it must be easy to stir and clean out.

These requirements can be easily met through the use of brick. However, we must choose a brick of a size that is easily and commonly extruded in Vietnam. The best candidate is the standard half-brick of an 87 mm length, of a 110 mm width and a 75 mm height. But the six holes of this standard brick are far too big: at 25 mm or one-inch diameter, mice and rats can easily make their way through.



So instead of a half-brick with 6 holes of a 25 mm diameter, we propose a half-brick with eight holes of a 14 mm diameter.¹ This brick can be bought wholesale for about 800 VND or 3.80 cents US.

¹ See Appendix II of this paper for a full set of drawings.



The total cost for the 108 bricks needed to construct a bin of a 70 cm interior diameter is about 86,400 VND or \$4.11 US (see picture on the left). The labor needed to lay the bricks is more or less one man-hour. The lids of this bin are formed in concrete on inexpensive sand molds shaped by the spinning of a radial arm – a technology available everywhere in Vietnam.

Note that this bin is well aerated: it has 864 aeration holes.

If a particular household has no outdoor space where a bin could be installed, but if a neighbor does, then arrangements could be

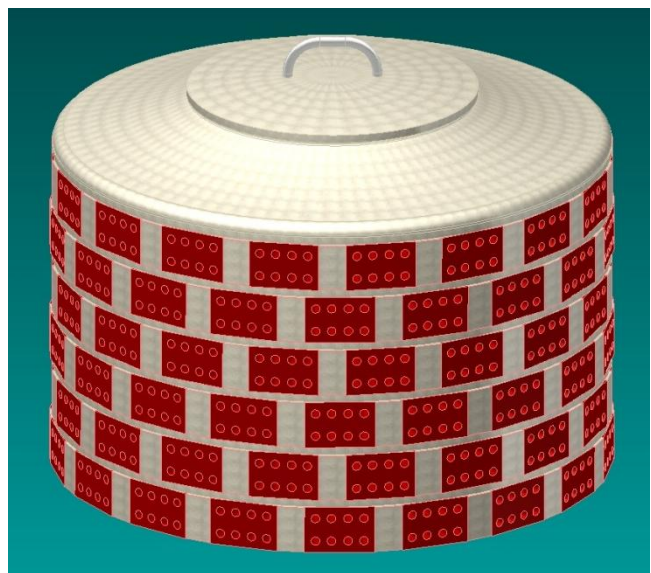
made for these two households to make use of the same bin. In Dalat over thirty households living in an apartment building shared a single mesophilic bin. This bin was located in a small flower garden near the apartment building, and it received on average more than 30 kg's of bio-waste per day. It was able to handle such a large quantity of waste due to the fact that it was well populated by the larvae of the black soldier fly – a creature that will be explained further in the following section.

If need be, households on an entire section of a street could all make use of the same bin or series of bins. In this case, each household would isolate its bio-waste in plastic sacks that a scavenger could collect and bring to the shared bin or bins.

Mesophilic creatures require oxygen. That is why the sides of the bin have aeration holes. But these holes are not enough to keep the contents of the bin fully aerated. A certain amount of stirring is required. A significant amount of stirring is done by larvae of the black soldier fly. But this natural stirring is still not enough. Humans must also help out from time to time, otherwise foul odors are created. It is not necessary to remove the large lid each time the contents of the bin must be stirred. There is ample access into the bin simply by removing the small lid.

In this concept, bio-waste goes directly from the house into the bin, and it never comes into contact with other types of waste. This is absolutely critical in any recycling effort. If source-separation does not take place, then it will be impossible to separate bio-waste from a long list of materials that might contaminate it. If compost, for example, is produced from previously commingled materials, this compost will be toxic and dangerous, and totally unfit for agriculture.

This storage unit is designed to receive waste that naturally breaks down within a period of about one year (bone and shell are the only exceptions). Materials that do not break down include



glass, metal, plastic, rubber, foam rubber, wax-coated items, textile, stone, sand, rock, rock wool, sponge, brick, porcelain, ceramic and other such durable items. These items should never be put into this storage unit.

Of course we should not put into this storage bin bio-waste that is recyclable. But at times paper becomes wet or soiled and is not valued by scavengers. Such paper can be put into the storage bin, together with soiled toilet paper and paper towels.

Food preparation waste and table scraps belong in this storage bin.² Food preparation waste includes nut, fruit and vegetable matter along with their seeds, peelings or shells. It also includes poultry, meat and fish cleaning residuals, including feathers, scales, shells, bone and hair. Table scraps include all food waste left over from a pot, dish or plate, along with any bones, scales, and shells. Soups and broths can be put into the unit, provided there is sufficient waste paper in the unit to absorb these liquids. If the unit does not contain enough absorbent materials, then the soups and broths should be sieved to extract fine solids, and only the solids should be put into the bin.

Spent bouquets of flowers can be put into the bin. Small amounts of garden waste are also acceptable. Large amounts of garden waste would quickly fill up the bin and should be kept out. If a household generates large amounts of garden waste, and if it has sufficient space, it might be provided with a swath of compost fleece - a cover that will be explained further on. Once again several households might make use of the same compost fleece.

Large branches and pieces of wood should not be put into the storage unit or compost pile. They should be collected, perhaps, on a weekly basis and shredded at a decentralized site. Some of this material can be used as mulch, some as a bulking material for thermophilic composting, or some as a feedstock for gasification.

About a year and a half ago, 30 mesophilic storage units were set up on in the village of Xuan Tho in Vietnam. One bin in particular was closely studied after it had been in operation for eight months. During this time, this bin had received a total of about 720 kg's of biodegradable solids (960 liters). At the end of this period, there had been a 92% reduction in the weight of the waste and a 79% reduction in its volume.

There are no unpleasant odors coming from such bins. There are no flies. Effective microorganisms can be added to the bin from time to time to accelerate the mesophilic decomposition and further eliminate odor. Even though a bin might receive 3 kg's of waste per day, it would only have to be cleaned once every year or two. After clean-out, the contents of the storage bins might be brought to a small site where they would be shredded and then routed to thermophilic composting operations using a compost fleece. This cured biomass serves as an effective aeration and starter material for thermophilic composting. A far more exciting way to add value to this shredded material will be explained shortly.

As noted in the introduction, estimates of the average yearly cost per household of collecting, transporting and land-filling waste situate at about \$30 USD or 600,000 VND per year. The cost of constructing a mesophilic storage unit of a 70 cm interior diameter is less than \$12 USD or 250,000 VND. Therefore the cost of a bin can be recovered within a matter of months. Since these bins are designed to last indefinitely, the long-term savings are huge.

² Food preparation waste and table scraps from households could, at times, be subjected to a special collection where they would be pasteurized and fed to pigs, as will be explained later on.

Furthermore, one mesophilic bin can offset about one ton of CO₂ per year, and certified emission reduction (CER) credits are projected to trade for about \$20 USD or 400,000 VND per ton of CO₂. If one mesophilic bin can eliminate a cost of \$30 USD and if, at the same time, it can earn a profit of \$20 USD, it represents an incredible economic opportunity for waste management authorities. Note that this \$50 USD or 1,000,000 VND per household does not yet include revenue from the sale of the many products derived from waste.