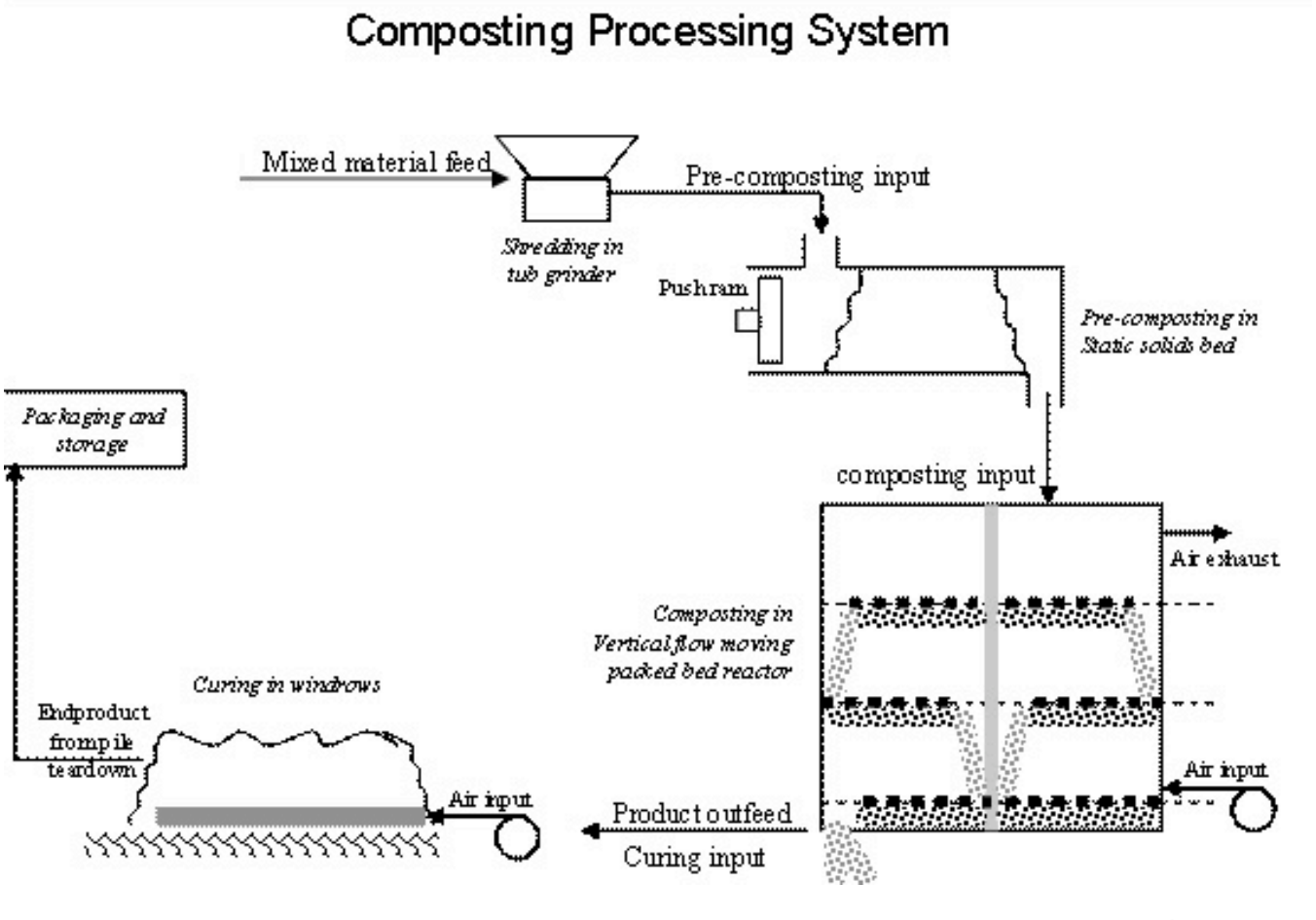
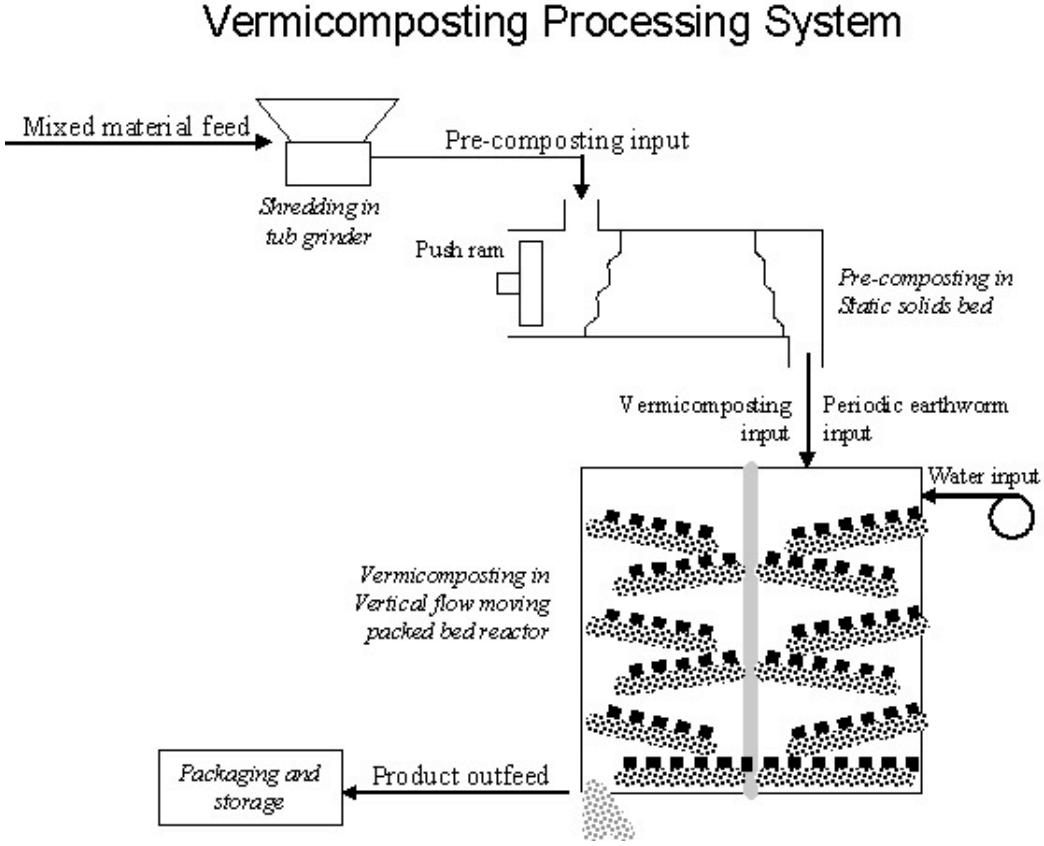
Contrasting Composting and Vermicomposting systems





In both vermicomposting and composting systems, all cases waste needs to be transported with a payloader, shredded and mixed. This would reduce particle size and accelerate decomposition.

Vertical Flow reactor for composting and vermicomposting
For comparison purposes both composting and vermicomposting are assumed to be carried out in a same vertical flow moving packed bed reactor with multiple hearths (fig 2.3A p 33 in Practical Handbook of Compost Engineering). In a vertical flow moving packed bed reactor waste is placed on beds stacked vertical inside a reactor and periodically agitated as to transport the waste to next bed down, as the very lowest bed is emptied of the finished product and the top most bed filled with fresh feedstock. This reactor allows composting to go on during the cold season without having to place the entire process indoors. The reactor was modified for vermicomposting as explained in the figure above.

Modified vertical flow reactor for vermicomposting
The vertical flow moving packed bed reactor is convenient for vermicomposting if the bed moving mechanisms is activated intermittently. In this case the earthworms will process the waste before it's transferred to a lower bed. The reactor can include a larger number of hearths since earthworms require waste to be in thin layers, as to prevent composting and heating up. Forced aeration is also omitted because earthworm burrowing achieves the required aeration and because excessive aeration would make it difficult to maintain the targeted 75% moisture level (see Table a). A sprinkler system across all beds was added to maintain the 75% moisture level. Also the vertical distance between the hearths is small and they're slightly inclined as to create a point of contact between waste layers (due to residual waste piling upon agitation). Earthworms would migrate across these points of contact into the next waste layer once the lower one is fully processed. The earthworm which would be used, *Eisenia foetida* has been demonstrated to migrate towards fresher food sources.

Pre-composting used in both composting and vermicomposting
Both systems involve pre-composting as a means to store the feedstocks before intermittently loading the vertical flow moving packed bed reactor. Also vermicomposting requires pre-composting of the feed before adding it to the earthworms since in Ndegwa & Thompson (2001) it was shown that initial pre-composting results in a higher quality vermicompost end-product. For pre-composting, a static solids bed reactor - push type is used, but without an aeration system under the bed. The push ram action conveniently creates space for more feedstocks and pushes some pre-composted material out, to be added to the reactor. Aeration is not necessary due to the short term of this composting process. Earthworms favor pre-composted feed for up to 2 weeks only and in the composting system the purpose of this phase is largely to store feedstocks until the next feeding into the reactor. Using a closed bin for pre-composting also secures continued operation during cold seasons without having to house the entire process within a hangar.

Time and space requirements in composting vs. vermicomposting
As shown in the figure above, compared to vermicomposting, composting requires additional space for curing, whereas vermicompost can be packaged and marketed either immediately, or after a 2-week nitrification period where microbial activity re-surges in the casts and ammonium in the earthworms casts is nitrified. Also, at the optimal density of 150 earthworms / liter of waste, the residence time in the vertical reactor is a constant 20-30 days, depending on the waste density, whereas composting requires about 3 months, and 1 to 4 months of curing.