

DESIGN AND PERFORMANCE EVALUATION OF AN AXIAL-FLOW-TYPE BIOMASS SHREDDER

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ABSTRACT

Conversion of biomass wastes, specifically agricultural by-products, into a useful organic fertilizer using a biomass shredder is becoming popular. The high investment cost for this machine, however, hinders many farmers to practice composting. In order to make this technology available and affordable to end-users, the Office of the Assistant to the President on Environmental Concern and the Appropriate Technology Center, Department of Agricultural Engineering, College of Agriculture, Central Philippine University had collaborated to design and evaluate a low-cost axial-flow-type biomass shredder. The design, fabrication, and performance evaluation of the shredder were carried out from July to August, 2002.

The biomass shredder consists of the following parts, namely: (a) a feeding tray, where waste materials such as grasses, straws and leaves are fed; (b) a shredding chamber, where the materials are subjected to cutting action by the rotating knives and cutter and to shearing action by the impact of the beater; (c) a fan assembly, which creates suction of the shredded materials and pushes it out from the machine; (d) a discharge chute, which serves as the outlet of the shredded materials; (e) a chipping plate,

which cuts wooden trunk into smaller chips; (f) a frame assembly, which supports the different components of the shredder; (g) a power transmission assembly, which transmits power from the engine to the shredding cylinder at a required rate; and (h) a power source, which supplies the power needed to operate the machine.

Operation of the biomass shredder follows the principle of an axial-flow thresher, in which the waste materials loaded into the feeding tray move axially with the shaft of the machine. After the materials were loaded into the tray, they undergo cutting and shearing actions through the shredding chamber's cutter, knives, and beater. It requires only one person to operate.

Performance evaluation of the machine revealed that it has an average throughput capacity of 2 kg per minute. Its capacity per disk, knife, beater and cutter were also obtained at 0.98 kg per min, 0.33 kg per min, 0.49 kg per min, and 0.49 kg/min, respectively. Further test also showed that the machine has an average fuel consumption rate of 0.028 li/min and a percentage change in volume of shredded product of 35.67 percent.

The machine can be fabricated in a small shop using local materials at a cost of P35,000.00 (excluding the engine). Operating cost analysis revealed that the machine can shred biomass wastes at P0.51 per kg. Comparing this with the commercially-available shredder, the axial-flow type biomass has a payback period of about 2 months, a benefit-cost ratio of 2.18, and a return on investment of 694.74 percent.