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ASSESSMENT OF TECHNO-ECONOMIC FEASIBILITY OF SOLAR-POWER OPERATED SHREDDER FOR AGRICULTURAL RESIDUE

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Abstract

This study evaluated the techno-economic feasibility of solar biomass shredder and determined its capacity, shredding efficiency, and power consumption. Agricultural residues (wheat and paddy straw) were selected and shredded at three rotational speeds (RPM) (1500, 2500, 3500) and five moisture contents (MC) (6, 8, 10, 12, 14%) for evaluating its shredding efficiency. Wheat was shredded at additional MC of 16% and 18%. Optimum shredding efficiencies were more than 95% and maximum capacity of 60.39 kg/h and 55.61 kg/h were obtained at 6% MC and 3500 RPM for both residues. The highest power consumption was found 1.86 kWh and 2.2 kWh/h at 18% MC and 3500 RPM for wheat straw and at 14% MC with 3500 RPM for paddy straw, respectively. Maximum bulk density was observed at 18% MC and 3500 rpm for wheat straw (47.3 kg/m^3) and 14% MC and 3500 RPM for paddy straw (53.14 kg/m^3). Particle size distribution was also studied for shredded crop residues through sieve analysis. Maximum average lengths were recorded at 1500 RPM as 76.73 mm at 18% MC for wheat and 71.78 mm at 14% MC for paddy straw. The payback period and benefit-cost ratio of the shredder were found 2.86 years and 7.0. Solar biomass shredder offers promising solution for the sustainable management of agricultural residues as it is considered the main step for benefiting from crop residues either for feeding livestock, composting, and production of biofuels, etc. It not only promotes eco-friendly and efficient farming but also supports farmers in achieving economic stability.

Key words: agricultural residues, cost-economics, shredding efficiency, solar-biomass shredder

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