U.S. Department of Transportation

SunGrant INITIATIVE

Northeast Region

DEVELOPMENT OF SQUARE BALE HANDLING SYSTEMS

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Bulk densification of a biomass feedstock at a satellite storage location adds great value, if done in a cost effective way. Studying mechanical and operational performance of existing bale compression machines will discover all factors that affect the entire supply system. Moreover, possible means of modifying the existing machine for the purpose of biomass densification will be addressed with the goal of reducing the machine cost. This study will solve these problems and propose an efficient way to handle and transport square bales.

Among existing harvesting machine systems, baler-based and forage harvester-based machine systems are most popular. The baler-based system is primarily used for harvesting dry materials such as crop residues and energy crops. This harvesting system produces bales. The forage harvester system is used for harvesting wet crops, producing truckloads of chopped loose materials. The bales will be collected from fields and then transported to a satellite storage location (SSL) preferably nearby an established roadway. A SSL is a connecting point between farm gate and the transportation network. Loading bales efficiently and safely onto a truck will greatly impact the entire supply system. The investigator has attended several meetings with landowners who may operate SSL facilities and managers of a bioenergy plant; efficient operations and induced costs at SSL are the main concern. Inefficiencies of these systems will limit the material flow from SSL to bioenergy plant. Therefore, development of efficient loading and unloading techniques and required mechanical devices are definitely needed.

To address these problems for biomass feedstock logistics, the proposed study will focus on square bale handling technologies and costs of bale densification. Long-term goals are to develop efficient logistics systems and required mechanical devices for handling biomass feedstocks in a safe, low cost and efficient manner. Specific objectives of this study are as follows: (1) Study existing bale compressing equipment using hay and switchgrass to collect data including mechanical performance, investment and operating costs, storage requirements, and to gain potential means of machine modifications to reduce the cost of machine fabrication; (2) Develop a loading and unloading technology and required devices to reduce operating costs and utilize the full capacity of a flatbed truck; (3) Establish a model for square bale handling systems, which can predict various costs including, collecting square bales from fields, loading bales onto a truck at SSL, and bale recompression.

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