Improving Efficiencies in Forest Biomass Transportation

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Introduction

In the United States, comminuted forest biomass from harvest residues is mainly transported from the forest to bioenergy facilities using trucks equipped with single trailers of different capacities. Truck-trailer capacity is a function of the truck power-torque, trailer dimensions, transportation regulations, and bulk density of the processed biomass. Current fossil fuel prices have raised transportation costs, increasing the interest in cost-effective strategies to reduce the cost. Increasing hauling capacity by using larger trailers is often the most intuitive alternative. However, in steep terrain operations, low standard roads, adverse grades and tight curves can limit the ability to drive larger single trailers to the comminution site. If access to larger single trailers is not permitted, then maximizing the capacity of shorter truck-trailers becomes more important to increase the amount of comminuted forest biomass per truck per trip.

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FIGURE 1.– a) Loading grindings with an experimental chip flinger; b) Conventional conveyor-fed truck loading.

Objectives

Our main objective is to increase truck capacity per trailer per trip to decrease transportation costs. Our analysis is focused on harvest residues comminuted in the field using grinding. Grindings compared to chips are a less homogeneous material. We are also interested in the evaluation of different truck-trailer configurations to maximize loading capacity without exceeding the legal weight limits for different truck-trailer configurations.

Methods

We tested different techniques to increase truck capacity of single trailers. These techniques include the use of a high speed blower system that increase the velocity of grindings into the trailers. An experimental chip-flinger was also tested in loading . In addition, a simulation model was developed to understand the potential benefits and limits of using the 32-32 ft long double trailer configuration compared to the use of single trailers (Figure 2).

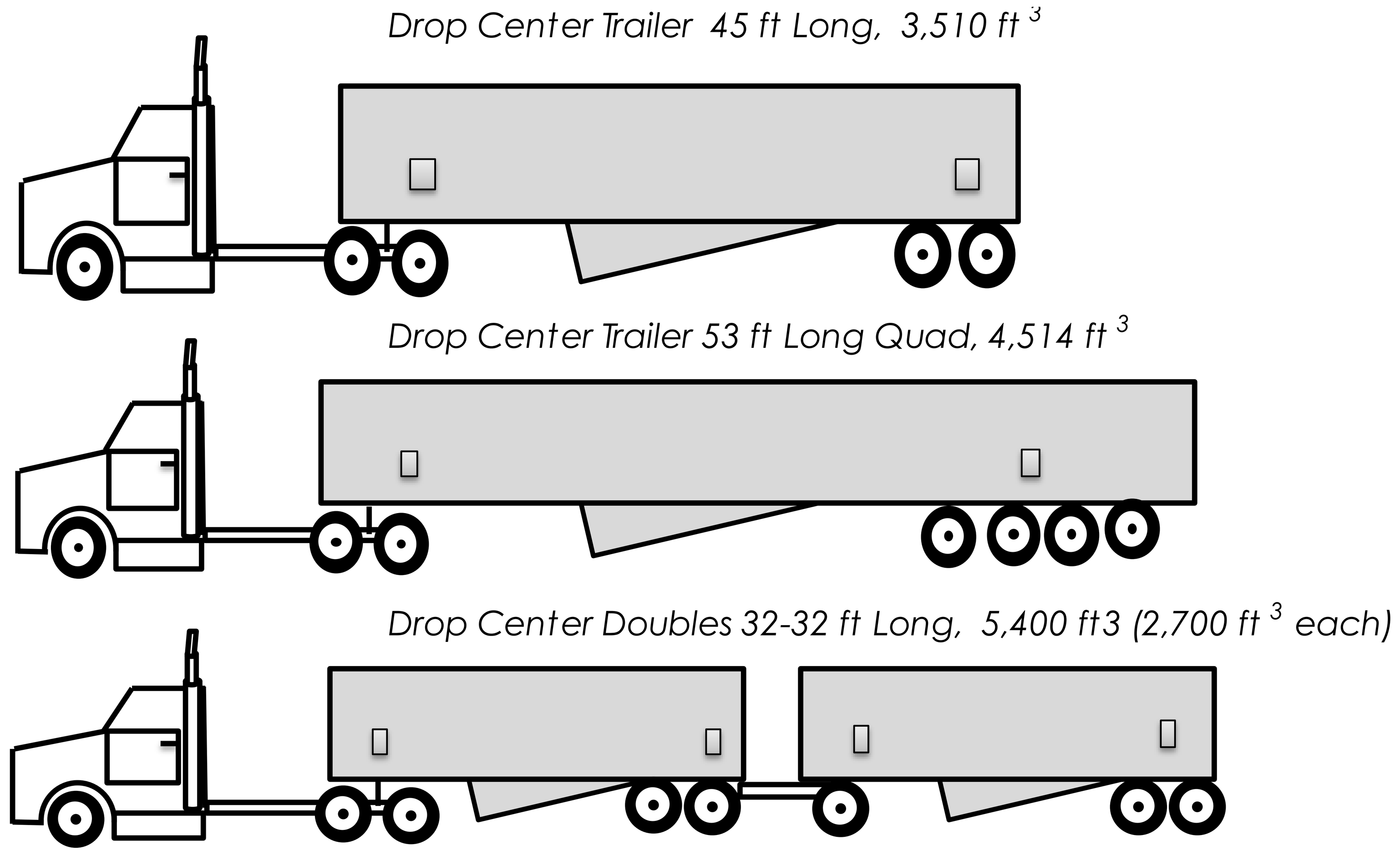

FIGURE 2. – Different truck-trailer configurations to haul forest biomass. Oregon and Washington maximum allowable weight is 105,500 lbs.

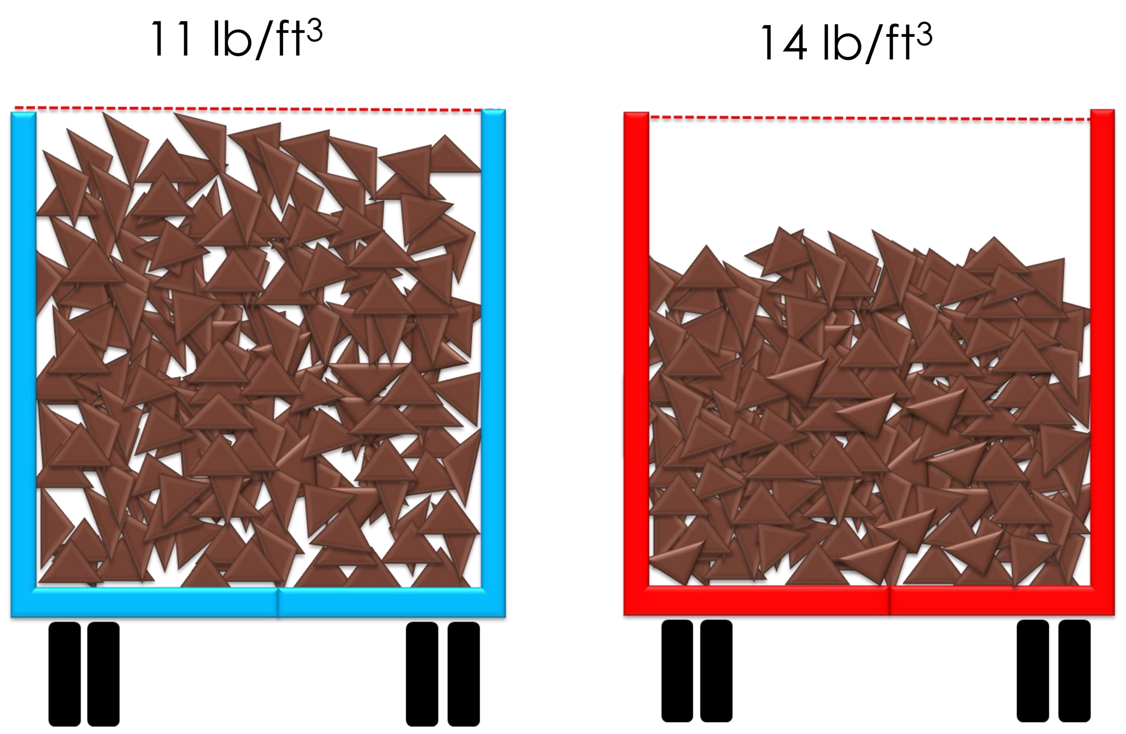

FIGURE 3.– Example of an increase in bulk density in trailers by increasing compaction

Analysis and Results

Preliminary results suggest that the high speed blowing could increase the single trailer capacity between 21 to 27%. The prototype chip-flinger produced an increase in bulk density ranging from of 12 to 20% (Figure 4). The potential use of the double trailers is a function of the distance between the piles and the hook-up point.

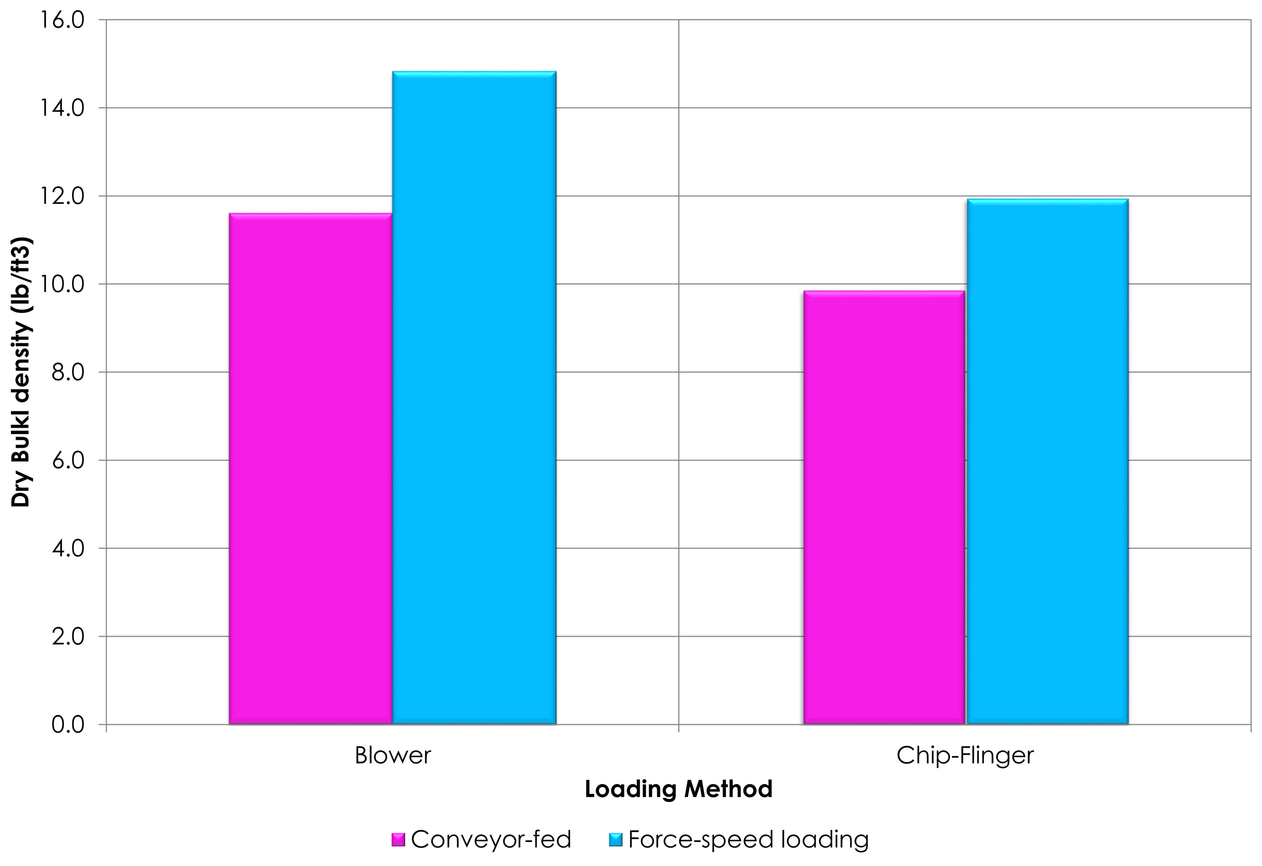

FIGURE 4.– Differences in dry bulk density between the conveyor-fed and force-speed loading methods.

Currently, we are evaluating the effect of the chip-flinger speed on the compaction level of the load. We are also evaluating different techniques to improve the volume estimation in chip trailers. This techniques include the use of unmanned aerial vehicles and digital image analysis.

FIGURE 5.– Chip-flinger loading experiment in Junction City, Oregon.

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